ARO WORKSHOP

ANALYTICAL AND COMPUTATIONAL ISSUES IN LOGISTICS R&D

MAY 7-9, 1984

Volume 1

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U. S. Army Research Office

December 1984

PROCEEDINGS OF THE ARO WORKSHOP ON ANALYTICAL AND COMPUTATIONAL ISSUES IN LOGISTICS R&D

VOLUME 1

Sponsored by

The Mathematical Sciences Division

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Held at

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7-9 May 1984

U. S. Army Research Office
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Research Triangle Park, North Carolina

FOREWARD

This volume and its companion contain the proceedings of an ~~ARO~~ workshop on logistics research held at the George Washington University on 7-9 May 1984. The ARO workshop concept is to bring a dozen, or so, researchers in a well defined scientific area together with Army scientists and engineers with similar interests. The primary goal of these workshops is communication. Formal presentations by each group stimulate discussions, which in many cases, develop into very productive long range interactions. At a more basic level, the Army participants are presented with a survey of recent results while the researchers are presented with new motivating problems for future research.

Logistics is a very broad field of endeavor, encompassing many academic disciplines. For example, logistics practice uses concepts from management science, mathematical optimization theory, network analysis, reliability, quality control, queing theory, and many others. Because of this broad nature, the ARO workshop concept does not naturally accommodate this topic. There is, however, a mounting interest in logistics research at all levels within the Department of the Army because of the realization that the life cycle logistic costs of a weapon system amount to several times its initial development and production costs. Since there is no formal comprehensive outline of specific problems or issues whose solutions could streamline the practice of logistics in the Army, this workshop was a first step in establishing the necessary dialog for developing such an outline, at least for that part of the scientific community with which ARO interacts. It is hoped that there will be a series of follow-on meetings which will focus on more specialized topics of interest to researchers and the Army alike. These meetings will likely take the form of workshops, working group meetings, and other committee functions. Each will have its own format and goal.

This workshop began with a special keynote presentation by Mr. Walter W. Hollis, Deputy Undersecretary of the Army, Operations Research. Mr. Hollis developed the very broad outlines of the logistics problem from the perspective of his office, while subsequent presentations gave more highly resolved treatments of this problem. The papers presented by the academic researchers also followed this general pattern. An effort was made to group the academic talks with the Army talks which were most similar in content, in the workshop agenda.

The agenda is produced in the beginning pages of the first volume of these proceedings. Because of the pressure of work, some of the participants were not able to provide a copy of their papers. The reproduction of the proceedings was, therefore, delayed to accommodate as many of the papers as possible.

The presentations of the Army participants tend to be factual outlines of mission oriented work competently performed over a long period of time. The academic papers, on the other hand, are reports of recent research results along with directions for current and future research. The continuing nature of academic research is reflected in the fact, that the titles of the papers in the latter category differ from the titles given in the agenda. Due to the very different nature of the two types of talks, therefore, the proceedings are compiled in two volumes. It is hoped that this will make it a more useful document.

WORKSHOP AGENDA

KEYNOTE ADDRESS: A CONCEPT FOR THE EVALUATION OF LOGISTIC SUPPORTABILITY
Walter W. Hollis, Deputy Undersecretary of the Army - C. R.

THE ARMY PERSPECTIVE ON LOGISTICS R&D
William Kracov, DARCOM Headquarters

SOME AREAS FOR RESEARCH IN ANALYTICAL AND COMPUTATIONAL LOGISTICS
William H. Marlow, George Washington University

ILS PLANNING PROBLEM FOR NEW WEAPON SYSTEMS
Michael McGrath, Office of the Secretary of Defense

A STOCHASTIC NETWORK FORMULATION FOR PERFORMANCE ASSESSMENT AND LIFE-CYCLE MODELING IN COMPLEX SYSTEM DESIGN
Austin Lemoine, Ford Aerospace Corporation

LOGISTICS SUPPORT ANALYSIS TECHNIQUES REVIEW AND ANALYSIS
Leslie H. Adkins, US Army DARCOM Materiel Readiness Support Activity

CONTROL PROBLEMS IN NETWORKS OF QUEUES
Shaler Stidham, North Carolina State University

ACTIVITY NETWORKS: A STATUS REPORT
Salah Elmaghraby, North Carolina State University

LOGISTICS OPERATIONAL EFFECTIVENESS NETWORK ANALYSIS
Maureen Stark, Ballistic Research Laboratory

MARKOV MODELS OF MULTI-ECHELON, REPAIRABLE-ITEM INVENTORY SYSTEMS
Donald Gross, George Washington University

RELIABILITY AND FAULT TREE ANALYSIS USING EXPERT OPINION: A CONCEPTUAL FRAMEWORK
Nozer D. Singpurwalla, George Washington University

FORECASTING PERFORMANCE FOR SLOW MOVING ITEMS
Robert Deemer, Army Materiel Systems Analysis Activity

A GENERALIZED DYNAMIC LINEAR MODEL WITH A CONSTRAINT ON THE EXPECTED VALUE OF STATE VARIABLES

Jacob Tsao and R. E. Barlow, University of California, Berkeley

STUDYING MODEL ASSUMPTIONS IN PROCESS CONTROL

Charles P. Quesenberry, North Carolina State University

QUALITY IMPROVEMENT USING EXPERIMENTAL DESIGN

George E. P. Box, Mathematics Research Center, The University of Wisconsin

SUPPORTI'G THE FUTURE FORCE

J. Russell Wiltshire, HQ, Department of the Army

MODELS OF MILITARY COMBAT WITH LOGISTICS

John S. Maybee, University of Colorado, Boulder

OVERVIEW OF SELECTED TOPICS IN LOGISTICS R&D

Wilson Heaps, Army Materiel Systems Analysis Activity

SIMULATION OF NON-MARKOVIAN SYSTEMS

Donald L. Iglehart, Stanford University

PANEL DISCUSSION

Moderator, Jagdish Chandra

Panelists:
George E. P. Box, University of Wisconsin
Rolf Clark, George Washington University
Austin Lemoine, Ford Aerospace Corporation
William H. Marlow

OVERVIEW OF EXPERT SYSTEMS

Stephen Cross, Air Force Institute of Technology

SUPPORTABILITY IN OPERATIONAL TEST AND EVALUATION

Douglas McGowen, Operational Test and Evaluation Agency

ILS QUANTIFICATION

Thomas Lanagan, Army Logistics Center

INTEGER AND MIXED-INTEGER NONLINEAR PROGRAMMING FOR LOGISTICS R&D PROBLEMS

Richard Soland, George Washington University

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KEYNOTE ADDRESS

A CONCEPT FOR THE EVALUATION OF LOGISTIC SUPPORTABILITY

Walter W. Hollis
Deputy Undersecretary of the Army
Operations Research

Summary of Mr. Walter W. Hollis' Keynote Address
at
ARO Workshop on Logistics R&D
George Washington University
7 May 1984

Mr. Hollis opened his remarks by making four points--

Supportability is an important and timely topic.

Life cycle costs for most systems dominated by support costs.

Logistics R&D has at least two components--

R&D to increase the productivity of Combat Service Support Units, and

R&D as a part of system design to ensure reliability and maintainability are inherent in it.

In connection with the latter point he observed that he was concerned that the creation of, for example, reliability departments, may have led us to forget the very excellent concept of interdisciplinary design teams. He pointed out that we should not develop a we and thee attitude.

Following these general remarks, Mr. Hollis turned to the topic of Logistics Supportability Evaluations in support of the acquisition process. He emphasized the point that such evaluations to be credible could not rely on test data alone. It was explained in connection with this point that tests of size and length sufficient to a credible assessment would be unaffordable and would suffer from what is called the "persistence of the situational variable," i.e., one set of initial conditions - scenario, unit, test location, etc.

The challenge then to those who desire to evaluate logistic supportability is to find the proper mixture of test and simulation. Tests can provide the basic data as to the reliability and maintainability of specific item level systems (a tank, for example) repair times, frequency of parts usage but cannot provide realistically the impact of the supply system on supportability nor the assessment of the impact of the new item level system on the next higher level system in which it is embedded. The more rearward the need to assess supportability the more need for simulation as an evaluation tool.

Mr. Hollis left with the mathematicians in the audience the request that they think about existing simulations of the supportability process, reflect on the adequacy of these and suggest better approaches to the process of logistic supportability assessment.

ILS PLANNING PROBLEMS FOR NEW WEAPON SYSTEMS

Michael McGrath
Office of the Secretary of Defense

DEFINING THE ILS PLANNING PROBLEM

Michael F. McGrath
Office of the Secretary of Defense
May 7, 1984

OUTLINE

- BACKGROUND: INTEGRATED LOGISTIC SUPPORT (ILS) POLICIES
- DEFINING THE PROBLEM
  - OBJECTIVE FUNCTION
  - CONSTRAINTS
- TWO CURRENT "SOLUTION" TECHNIQUES AND THEIR LIMITATIONS
- RESEARCH AREAS AND POSSIBLE SOLUTION APPROACHES FOR THE FUTURE

CURRENT ILS POLICY
(DoD DIRECTIVE 5000.39, NOV 1983)

OBJECTIVE

"THE PRIMARY OBJECTIVE OF THE ILS PROGRAM SHALL BE TO ACHIEVE SYSTEM READINESS OBJECTIVES AT AN AFFORDABLE LIFE CYCLE COST."

SCOPE

TEN ILS ELEMENTS:

- MAINTENANCE PLANNING
- MANPOWER AND PERSONNEL
- SUPPLY SUPPORT
- SUPPORT EQUIPMENT
- TECHNICAL DATA
- TRAINING & TRAINING SUPPORT
- DESIGN INTERFACE
- COMPUTER RESOURCES SUPPORT
- FACILITIES
- PACKAGING, HANDLING, STORAGE & TRANSPORTATION

PROCESS

- **EARLY ACTIVITIES: (MIL-STD-1388-1A)**
  - — DESIGNING IN DESIRABLE SUPPORT CHARACTERISTICS
  - — DETERMINING MAINTENANCE CONCEPT, SUPPORT REQUIREMENTS
- **SUBSEQUENT ACTIVITIES:**
  - — ACQUISITION, EVALUATION AND DEPLOYMENT OF SUPPORT RESOURCES

3532-4

AN ANALYTICAL INTERPRETATION

MINIMIZE: LIFE CYCLE COST

SUBJECT TO: READINESS AND SUSTAINABILITY CONSTRAINTS

TECHNOLOGICAL CONSTRAINTS

RESOURCE CONSTRAINTS

OPERATIONAL AND LOGISTIC SCENARIO CONSTRAINTS

FORMULATION AS A NOTIONAL NONLINEAR PROGRAMMING PROBLEM

CONTROL VARIABLES (VECTORS)

d = DESIGN VARIABLES (MTBF, MTTR, # OF LRUs, UNIT COST, . . .)

s = SUPPORT RESOURCE VARIABLES (SPARES QUANTITIES, MAINTENANCE MANPOWER AND SKILL LEVELS, SUPPORT EQUIPMENT . . .)

m = MAINTENANCE CONCEPT VARIABLES (LEVEL OF REPAIR, SUPPLY ECHELONS, TRANSPORTATION MODES, . . .)

OBJECTIVE FUNCTION

c = LIFE CYCLE COST = f(d,s,m;p)

where

p = "FIXED" PARAMETERS (NUMBER OF END ITEMS, UTILIZATION RATE, . . .)

FORMULATION (CONT'D)

CONSTRAINTS

READINESS & SUSTAINABILITY:	$g_1(d,s,m;p) \geq 0$ $g_2(d,s,m;p) \geq 0$ • • •	**(OPERATIONAL AVAILABILITY, SURGE & SUSTAINED SORTIE RATES, . . .)**
TECHNOLOGICAL:	$g_6(d,s,m;p) \geq 0$ $g_7(d,s,m;p) \geq 0$ • • •	**(FEASIBLE BOUNDS ON R&M, TECHNICAL FEASIBILITY OF FIELD REPAIR, . . .)**
RESOURCE:	$g_{11}(d,s,m;p) \geq 0$ $g_{12}(d,s,m;p) \geq 0$ • • •	**(R&D FUNDS, PROCUREMENT FUNDS, O&M FUNDS, MANPOWER/SKILL LEVEL AVAILABILITY, . . .)**
OPERATIONAL AND LOGISTIC SCENARIO:	$g_{16}(d,s,m;p) \geq 0$ $g_{17}(d,s,m;p) \geq 0$ • • •	**(SCHEDULE, DEPLOYABILITY REQUIREMENTS, ORDER & SHIP TIMES, . . .)**

WHY NOT TAKE NLP PROBLEM LITERALLY?

TECHNICAL PROBLEMS

- FUNCTIONAL FORMS OF OBJECTIVE FUNCTION AND CONSTRAINTS ARE KNOWN ONLY PARTIALLY
- CONSTRAINTS MAY MAKE PROBLEM INFEASIBLE

MANAGEMENT PROBLEMS

- NUMBER OF CONTROL VARIABLES AND CONSTRAINTS CHANGES VIRTUALLY EVERY WEEK

CONCESSIONS TO PRAGMATISM

- ONE PERSON'S CONSTRAINT IS ANOTHER PERSON'S CONTROL VARIABLE
- ALTHOUGH "BEST" SOLUTION WOULD BE NICE, "GOOD ENOUGH" SOLUTION IS ACCEPTABLE (I.E., AFFORDABLE SOLUTION THAT MEETS THE IMPORTANT CONSTRAINTS)

CURRENT APPROACHES

1. WORK THE PROBLEM IN PIECES (PARTITIONING)

- DEAL WITH A SUBSET OF THE CONTROL VARIABLES AND KNOWN (OR ASSUMED) FUNCTIONAL FORMS FOR THE OBJECTIVE AND CONSTRAINTS

EXAMPLE: SPARING-TO-AVAILABILITY

- SESAME
- ACIM
- MOD METRIC
- AAM, et al

$$\min_{n_{ij}} \sum_{\text{items } i} \sum_{\text{locations } j} n_{ij} C_i$$

s.t. $A_O \geq \alpha$ where $A_O = f(n_{ij}, MTBF_i, MTTR_i, MSRT, SM\&R_i, \ldots)$

$n_{ij} \geq 0$, integer

EXAMPLE: LEVEL OF REPAIR ANALYSIS

- LOGAM
- LOR (MIL-1390)
- ORLA/NRLA

$$\min_{RL} \text{Support Cost} = f(\text{Repair Level}, n_{ij}, \ldots)$$

s.t. Repair Level = O, I, D, or "Discard" $\Longrightarrow$ $SM\&R_i$

WHAT'S WRONG WITH PARTITIONING?

NOTHING, IF:

- WILLING TO ACCEPT NON-OPTIMAL SOLUTIONS
- CAN ENSURE SEPARATE ANALYSES USE CONSISTENT ASSUMPTIONS AND INPUT DATA

NON-TRIVIAL MANAGEMENT PROBLEM
(MIL-STD-1388-2A, "LSAR", SHOULD HELP)

CURRENT APPROACHES

2. USE SIMULATION (UNKNOWN FUNCTIONS)
   - CHOOSE AFFORDABLE VALUES FOR A SUBSET OF THE CONTROL VARIABLES; SIMULATE IN A SCENARIO THAT MEETS OPERATIONAL AND LOGISTIC CONSTRAINTS; AND OBSERVE OUTPUT MEASURES OF INTEREST. CONDUCT SENSITIVITY EXCURSIONS.

EXAMPLE: AIR FORCE USE OF "LCOM" TO TEST THE SORTIE GENERATION RATES ACHIEVABLE FOR GIVEN MAINTENANCE MANNING AND SPARES LEVELS.

- AURA
- T-ARMS
- CASEE
- TIGER
- LCOM
- TSAR, et al

EXAMPLE: NAVY USE OF "TIGER" TO ESTIMATE THE OPERATIONAL AVAILABILITY OF COMPLEX SHIP COMBAT SYSTEMS, GIVEN COMPONENT RELIABILITY AND SPARES INPUTS

WHAT'S WRONG WITH SIMULATION?

NOTHING, AS A MEANS OF TESTING WHETHER CONSTRAINTS ARE MET. BUT:

- DIFFICULT TO OPTIMIZE, EVEN APPROXIMATELY

- CUMBERSOME — CURRENT MODELS AND APPLICATIONS TEND TO REQUIRE EXTENSIVE INPUT DATA AND COMPUTER TIME

FUTURE DIRECTIONS

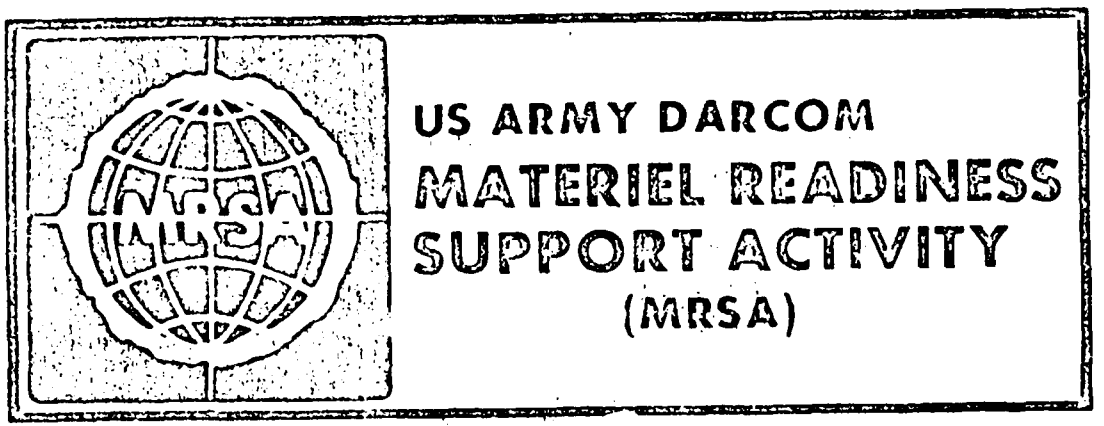
- CONTINUE TO WORK THE PROBLEM IN PARTITIONED FORM, BUT PERHAPS IN LARGER CHUNKS
- DISCIPLINE THE DATA BASE SO THAT SEPARATE ANALYSES WILL BE CONSISTENT (MIL-STD-1388-1A/2A)
- SEEK FURTHER DEVELOPMENT OF CLOSED FORM FUNCTIONAL EXPRESSIONS FOR THE OBJECTIVE AND CONSTRAINTS

RESEARCH AREAS

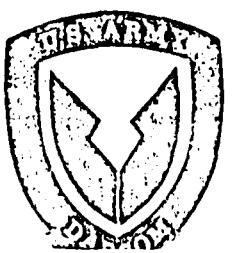
- STOCHASTIC MODELING APPROACHES TO TAKE ADDITIONAL CONSTRAINTS INTO ACCOUNT (IN CLOSED FORM). FOR EXAMPLE:
  - "SPARING TO AVAILABILITY" UNDER DYNAMIC CONDITIONS
  - FINITE POPULATION, FINITE REPAIR CAPACITY SPARING MODELS
- EXPANDED MODELS THAT CONSIDER MORE CONTROL VARIABLES SIMULTANEOUSLY. FOR EXAMPLE:
  - COMBINED SPARING TO AVAILABILITY AND LEVEL OF REPAIR MODELS (E.G., OATMEAL)
- APPROXIMATIONS FOR USE WITH LIMITED INPUT DATA
  - AGGREGATE SPARING TO AVAILABILITY APPROACHES
  - PARAMETRIC COST ESTIMATING RELATIONSHIPS

LOGISTICS SUPPORT ANALYSIS TECHNIQUES REVIEW AND ANALYSIS

Leslie H. Adkins
US Army DARCOM Materiel Readiness Support Activity

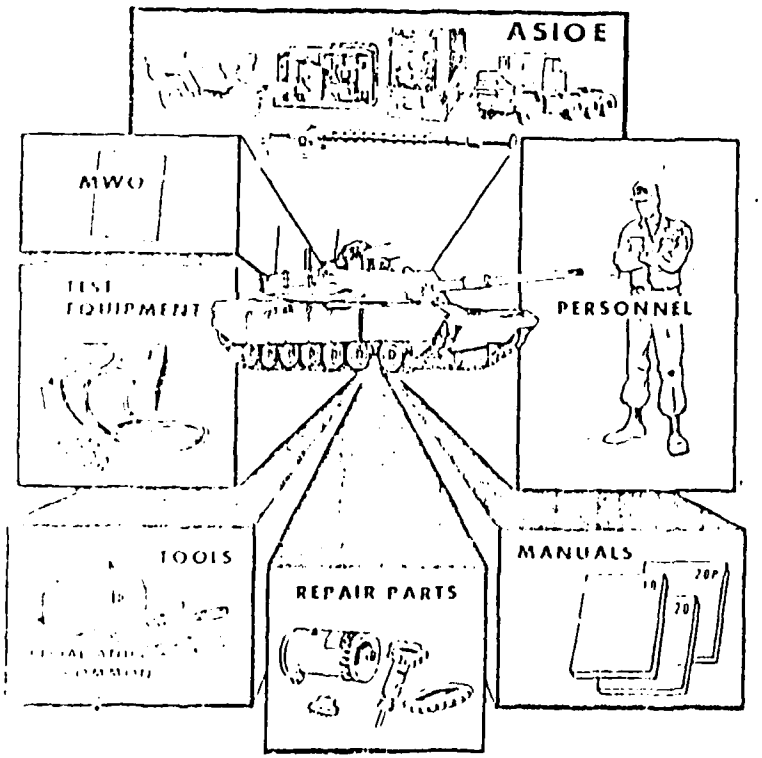


LEXINGTON, KENTUCKY



Good Afternoon. I'm Bud Adkins, for the US Army DARCOM Materiel Readiness Support Activity, or MRSA, Lexington, KY. I would like to briefly discuss some of the ongoing or planned activities at MRSA concerning Logistic Support Analysis Technique and models. More specifically I would like to discuss MRSA's LSA techniques technical review and analysis efforts.

US ARMY DARCOM
MATERIEL READINESS SUPPORT ACTIVITY



MISSION

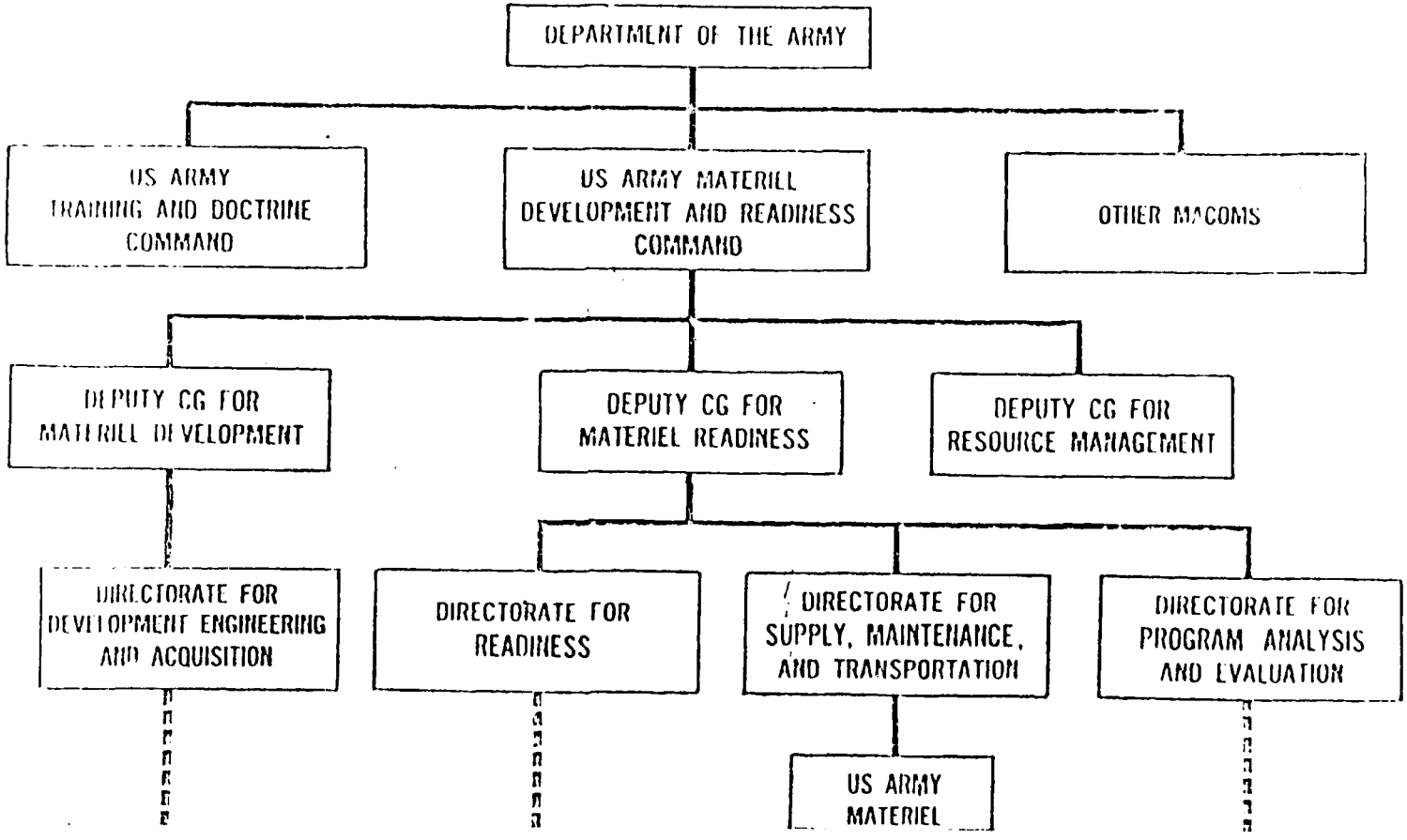
TO PROVIDE LOGISTICS ANALYSES AND EVALUATIONS AND OTHER TECHNICAL AND MANAGEMENT SERVICES IN SUPPORT OF THE DARCOM MATERIEL READINESS MISSION DURING ALL PHASES OF THE LIFE CYCLE MANAGEMENT

THRUST

TO POSITIVELY INFLUENCE THE ARMY'S EFFORT TO FIELD FULLY SUPPORTABLE ITEMS OF EQUIPMENT TO THE SOLDIERS AND TO IMPROVE ARMY MATERIEL READINESS

DRSA's primary mission is as shown. We are involved in every phase of the materiel life cycle, from concept to disposal, and in every element of integrated logistic support. Our responsibilities range from assessments of new materiel systems, to analysis of a materiel systems readiness to be fielded, to determinations of final [illegible] of materiel systems that [illegible] practical to [illegible]

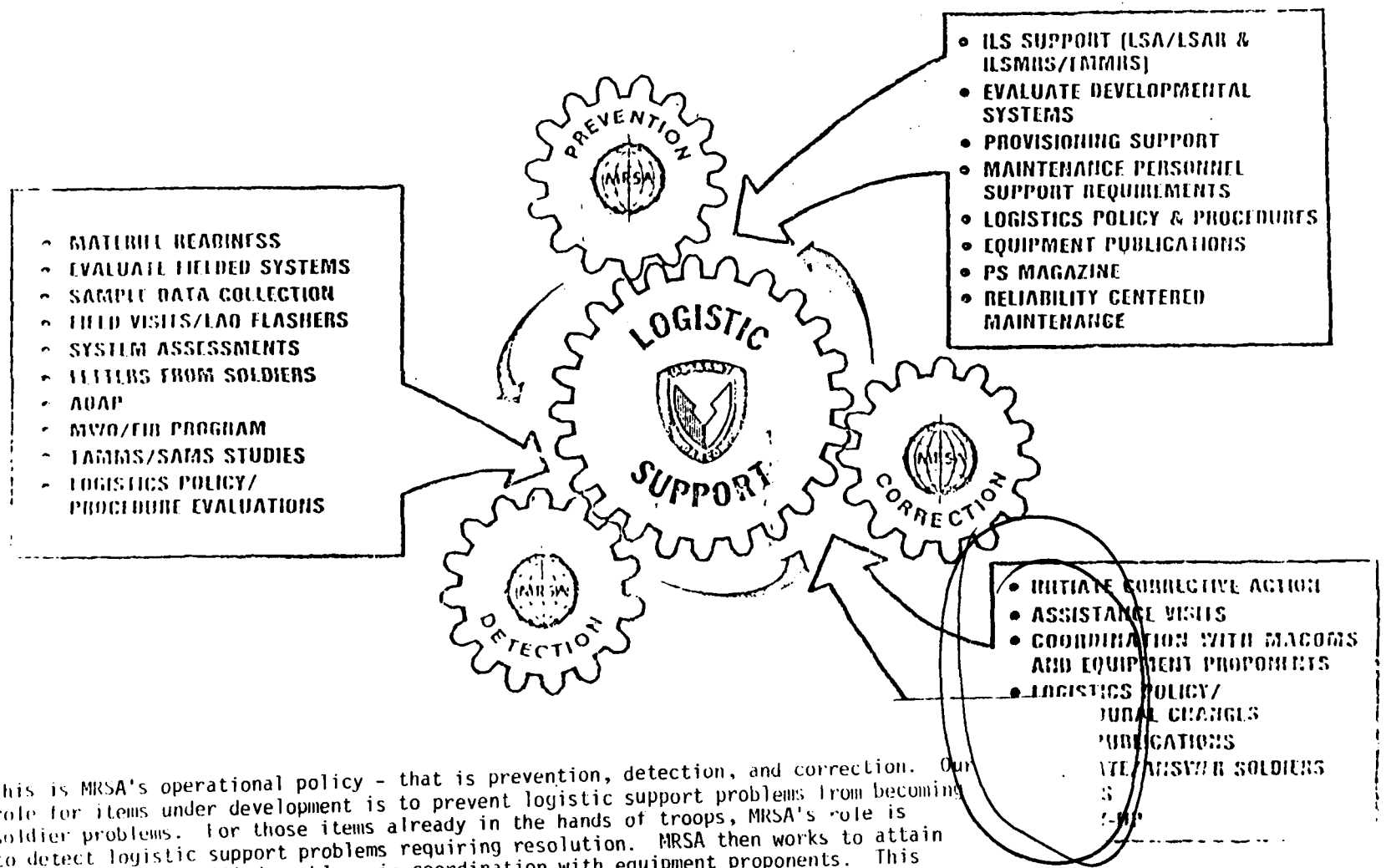
MRSA ORGANIZATIONAL RELATIONSHIPS



First, for the benefit of those who are not familiar with MRSA, we are an activity of about 400 personnel that reports to the US Army Materiel Development and Readiness Command (DARCOM) located in nearby Alexandria, VA. Although we report to MG Welsh, Director of supply, maintenance, and transportation, we receive tasking from most of the DARCOM directorates. In addition, we also have DA and DOD responsibilities.

MRSA OPERATIONAL POLICY

ACHIEVEMENT OF DARCOM GOALS

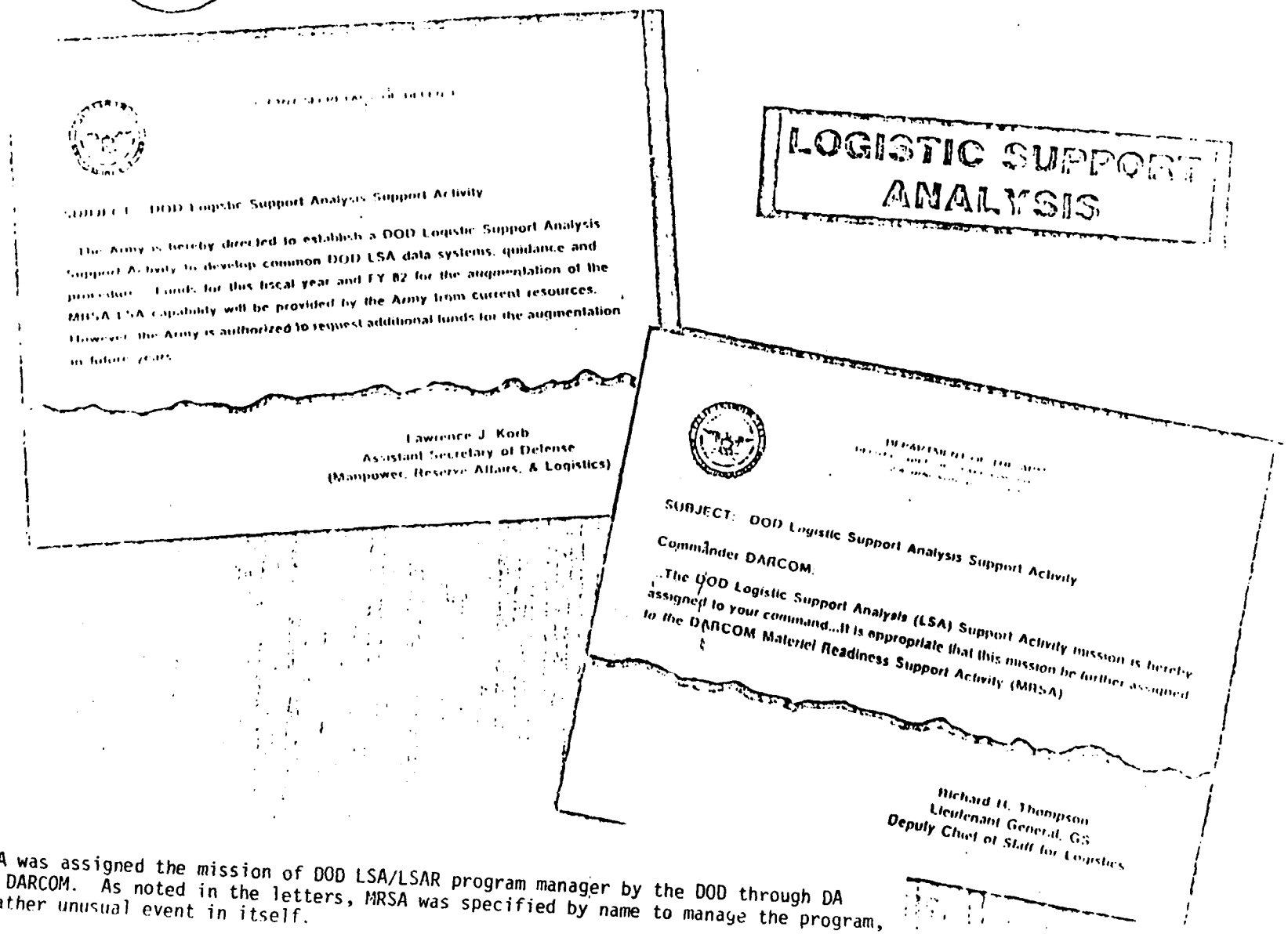


This is MRSA's operational policy - that is prevention, detection, and correction. Our role for items under development is to prevent logistic support problems from becoming soldier problems. For those items already in the hands of troops, MRSA's role is to detect logistic support problems requiring resolution. MRSA then works to attain correction to identified problems in coordination with equipment proponents. This again reflects MRSA's broad role throughout a materiel systems life cycle.

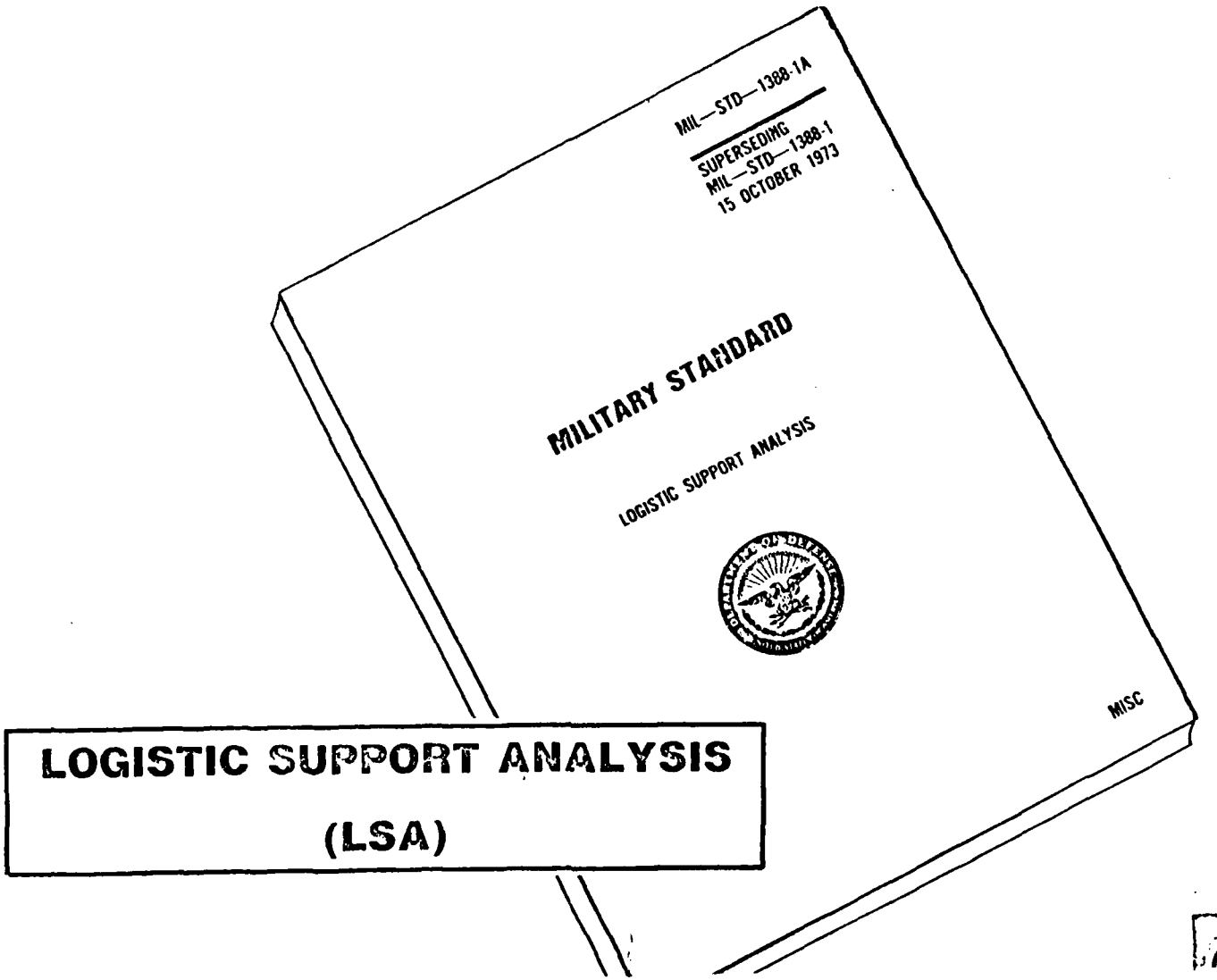
SIGNIFICANT FUNCTIONAL AREAS

- INTEGRATED LOGISTIC SUPPORT POLICY AND PROCEDURES FOR ARMY
- ARMY OIL ANALYSIS PROGRAM (AOAP)
- RELIABILITY IMPROVEMENT AND REPORTING SYSTEM
- ASSISTANCE AND CONSULTANT SERVICE TO MATERIEL DEVELOPERS/USERS
- ARMY SAMPLE DATA COLLECTION PROGRAM
- STANDARD ARMY MAINTENANCE SYSTEM
- LOGISTICS COORDINATOR FOR ARMY IR&D PROGRAM
- DOD TECHNICAL MANUAL STANDARDIZATION
- DOD LSA/LSAR

These are some the more significant functional areas in MRSA's mission. We draft and publish Army ILS policy and procedures in the form of pamphlets and regulations. We provide assistance and consulting service to Army materiel developers and users. We are the logistic coordinator for the Army IR&D program and provide logistic guidance to both IR&D participants and IR&D technical evaluators. MRSA is also the manager of the DOD LSA.LSAR program and it is in this program that the LSA techniques are applied.

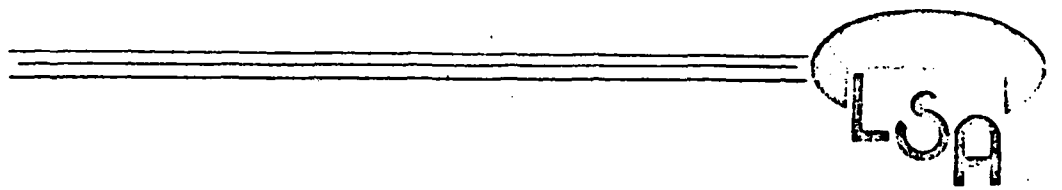


MRSA was assigned the mission of DOD LSA/LSAR program manager by the DOD through DA and DARCOM. As noted in the letters, MRSA was specified by name to manage the program, a rather unusual event in itself.



There are two documents associated with the LSA/SLAR program. One document is MIL-STD-1388-1A, Logistic Support Analysis. This standard recently underwent a major revision and was published in Oct 84.

Logistic
Support
Analysis



LOGISTIC SUPPORT ANALYSIS
MIL-STD 1388-1A

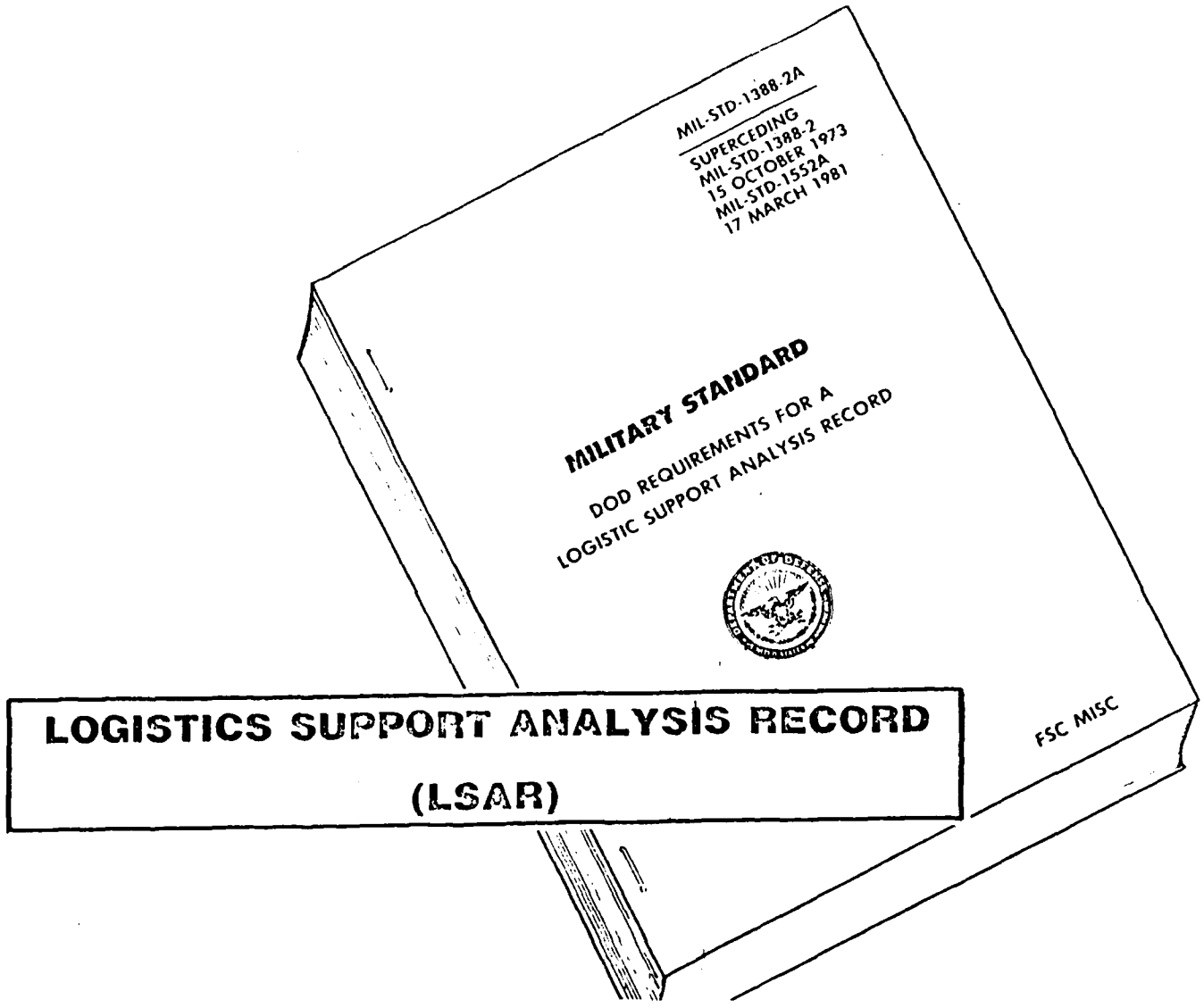
PURPOSE

- PROVIDES GENERAL REQUIREMENTS AND TASK DESCRIPTIONS FOR THE PERFORMANCE OF LSA DURING THE LIFE CYCLE OF SYSTEMS/ EQUIPMENT

APPLICABILITY

- ALL SYSTEM/EQUIPMENT ACQUISITION PROGRAMS THROUGHOUT ALL PHASES OF THE LIFE CYCLE

The prupose of MIL-STD-1388-1A is as shown. LSA is designed to be applied throughout each phase of a material systems life cycle.



The other document is MIL-STD-1388-2A, Logistic Support Analysis Record. This document has recently been finalized as a draft and will be published in Jun 84. Both standards are DOD documents and are widely acclaimed throughout DOD and industry.

Logistic
Support
Analysis

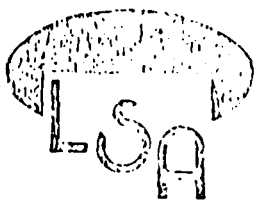
DOD REQUIREMENTS FOR A LOGISTIC SUPPORT ANALYSIS RECORD MIL-STD 1388-2A (DRAFT, MAR 83)

(PURPOSE)

- PRESCRIBE STANDARD LSAR DATA ELEMENTS, DEFINITIONS, AND DATA FIELD LENGTHS
- PRESCRIBES FORMAT OF LSAR REPORTS
- DEFINES LSAR MASTER FILE FORMATS AS COMMUNICATION LINK BETWEEN CONTRACTOR AND GOVERNMENT ADP SYSTEMS
- DEFINES LSAR INPUT FORMATS WHEN THE DOD LSAR ADP SYSTEM IS USED

The purpose of MIL-STD-1388-2A is as shown, the LSAR is primarily the record keeping process of LSA.

Logistic
Support
Analysis



DARCOM ILS STUDY

IDENTIFIED NEED TO:

- STRENGTHEN LSA PROGRAM
- DEVELOP MEANS TO BETTER CONDUCT LSA
- ESTABLISH A CENTER OF LSA EXPERTISE WITHIN DARCOM
- ESTABLISH LSA EXPERTISE WITHIN EACH MSC

In 1982, HQ DARCOM directed that a study be conducted to determine where the ILS program could be improved to be more responsive to the needs of Army materiel developers and users. One of the needs identified was to establish an LSA center of expertise and appoint an LSA executive agent.

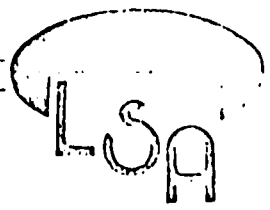
Logistic
Support
Analysis

LOGISTIC SUPPORT ANALYSIS

EXECUTIVE AGENT

MRSA was designated as the LSA executive agent in Sep 82, by HQ DARCOM.

Logistic
Support
Analysis

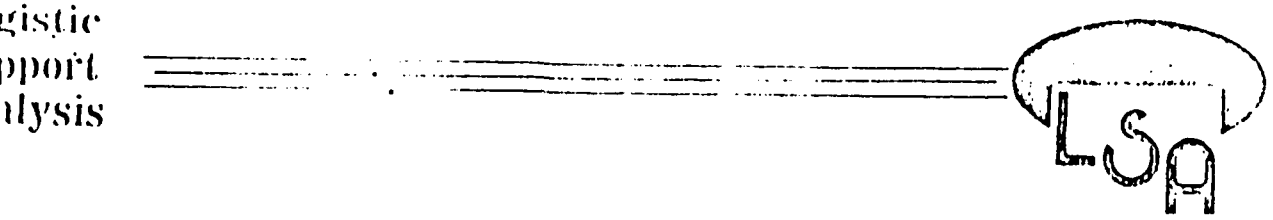


DARCOM
LSA EXECUTIVE AGENT
MISSION

- COORDINATE/DEVELOP LSA PROCEDURES/TECHNIQUES
- PROVIDE ASSISTANCE TO ALL DARCOM ACTIVITIES ON LSA
- ESTABLISH AN LSA CENTER OF EXPERTISE

This represents the mission assigned to MRSA as the LSA executive agent.

Logistic
Support
Analysis



DARCOM

LSA EXECUTIVE AGENT

MAJOR FUNCTIONS

- LSA TECHNIQUES GUIDE AND LIBRARY
- ANALYZE AND DEVELOP EXPERTISE ON SPECIFIC LSA TECHNIQUES
- VALIDATED PARAMETERS LIBRARY
- BRIDGING LSA REQUIREMENTS AND CURRENT TECHNIQUES
- OFF-THE-SHELF ANALYSIS TECHNIQUES

These are the major functions applicable to LSA techniques. The initial effort consisted of determining what LSA techniques/models were available within DOD and industry that could be applied to the LSA tasks identified in MIL-STD-1388-1A. Next was the conduct of a technical review and analysis of each technique to determine applicability and validity and the cataloging of the technqiue in the central library. The results of the analysis was to be documented in a technical report.

Logistic
Support
Analysis

LSA ENHANCEMENT & IMPLEMENTATION PLAN

CHAPTER 1 INTRODUCTION

CHAPTER 2 CONSOLIDATED BASE OF LOGISTIC MODELS
TASK 2-1: LIBRARY OF CURRENT LSA MODELS
TASK 2-2: LSA TECHNIQUES GUIDE

CHAPTER 3 INPUT DATA
TASK 3-1: VALIDATED LOGISTIC PARAMETER LIBRARY

CHAPTER 4 NEW TECHNIQUE REQUIREMENTS

CHAPTER 5 OFF-THE-SHELF ANALYSES
TASK 5-1: SPARC DATA FOR BATTLE DAMAGE
TASK 5-2: DISCARD/REPAIR COST MODEL
TASK 5-3: MTBR CALCULATIONS

CHAPTER 6 LSA TECHNIQUE APPLICATION & CO-ORDINATION
TASK 6-1: DARCOM/TRADOC LSA PROCEDURES HANDBOOK

This represents the outline of a five year program plan established to accomplish the LSA executive agent mission. Chapter 2 represents actions to identify, analyze, and cataloque techniques, and to document results of each. Chapter 3 represents actions essential to identify, validate and record standard inputs for LSA techniques. Chapter 4 is the effort to develop new techniques for application to LSA tasks where there are no existing techniques. Chapter 5 efforts will be to convert existing or develop new techniques to be "friendly", and rapidly executed with minimum training and hardware requirements.

Logistic
Support
Analysis

LSA TECHNIQUES GUIDE

DARCOM PAMPHLET 700-4
(FORMERLY DARCOM HDBK 700.3.1-82)

PURPOSE

- TO CATALOGUE CURRENTLY USED LSA TECHNIQUES
- TO ASSIST IN ACCOMPLISHMENT OF LSA

STATUS

- SCHEDULED PUBLICATION JUN 84

The document that cataloques the LSA techniques that have some applicability to the LSA tasks of MIL-STD-1388-1A is the LSA Techniques Guide, DARCOM PAM 700-4. This document, updated annually, will be published in Jun 84.

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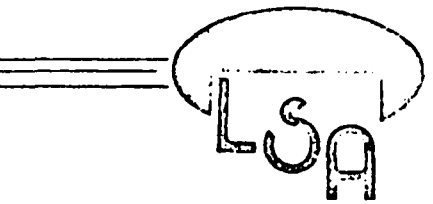

LSA TECHNIQUES GUIDE

1.2 TECHNIQUES QUALIFICATIONS

a. APPLICABLE TO AT LEAST ONE LSA SUBTASK

* b. SUPPORTED BY PROPONENT WITH AVAILABLE DOCUMENTATION

c. EXPORTABLE TO OTHER GEOGRAPHICAL LOCATIONS

d. APPLICABLE TO MORE THAN ONE SYSTEM

* e. SUCCESSFULLY APPLIED TO A SYSTEM WITHIN LAST 5 YEARS

* f. NOT SUPERSEDED BY A MORE PREFERRED METHOD AND BE A STAND ALONE TECHNIQUE

1.2.1 PROPRIETARY AND NONPROPRIETARY TECHNIQUES ARE ELIGIBLE

1.2.2 TECHNIQUES UNDER DEVELOPMENT ARE ELIGIBLE

Before a technique can be included in the techniques guide, it must meet these criteria. Exportability can be waived for proprietary models that have good application merits. If a technique is undergoing development, criteria elements may be waived until the technique matters.

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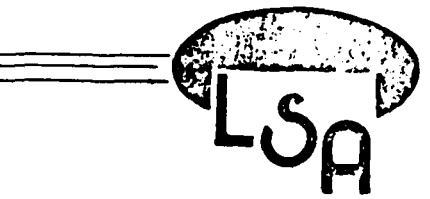

LSA TECHNIQUES GUIDE

SUMMARY

QUANTITY	CATEGORY
86	MET QUALIFICATIONS (33 OF ORIGINAL 52)
49	FAILED TO MEET QUALIFICATIONS (19 OF ORIGINAL 52)
16	INSUFFICIENT INFO
151	TOTAL TECHNIQUES CONSIDERED

The current techniques guide contains detailed information on 86 of the known 151 techniques. A brief reference is made to the remaining 65 techniques in an appendix to the guide. A technical review and analysis will be conducted only on those techniques with known LSA applicability.

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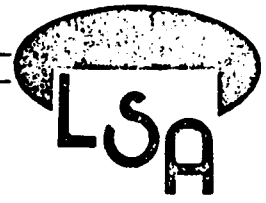
Support
Analysis



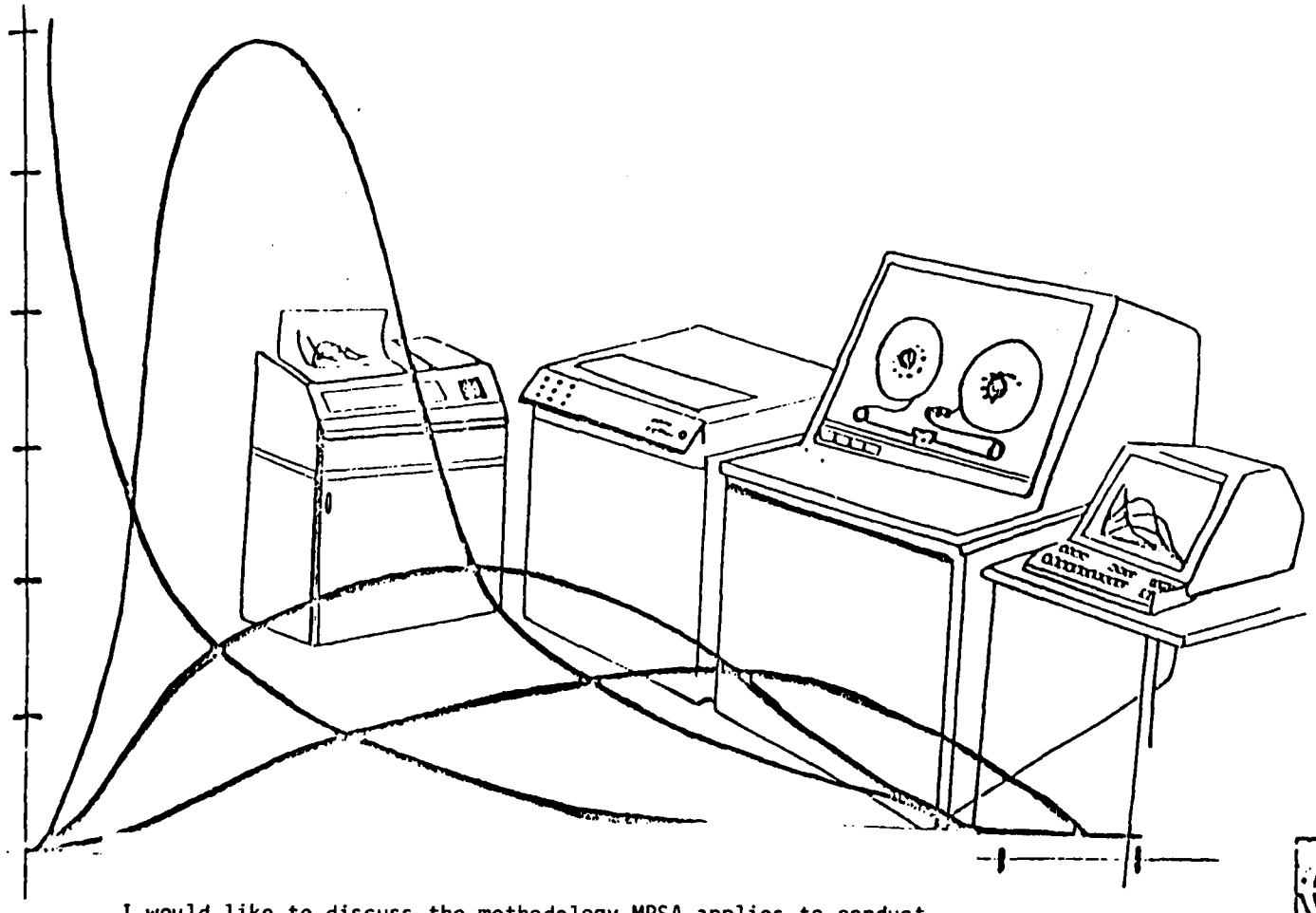
LSA TECHNIQUES GUIDE

LSA TECHNIQUES INFORMATION

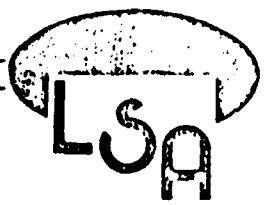
- PURPOSE AND DESCRIPTION
- PROPONENT AND CURRENT USER'S
- INPUTS AND OUTPUTS
- AUTOMATION INFO
- DOCUMENTATION AVAILABLE
- MODEL TYPE
- LEVEL OF DETAIL
- OPERATIONAL SCENARIO
- APPLICATIONS
- LIFE CYCLE PHASES INTERFACE
- LSAR INTERFACE
- LSA TASK INTERFACE
- ILS ELEMENT INTERFACE

This is the detail of information contained in the Techniques Guide for each of the techniques having known LSA application, e.g., the purpose for which the technique was designed, the ADP requirements for technique execution, points of contacts for assistance in application.

LSA TECHNIQUE ANALYSIS METHODOLOGY



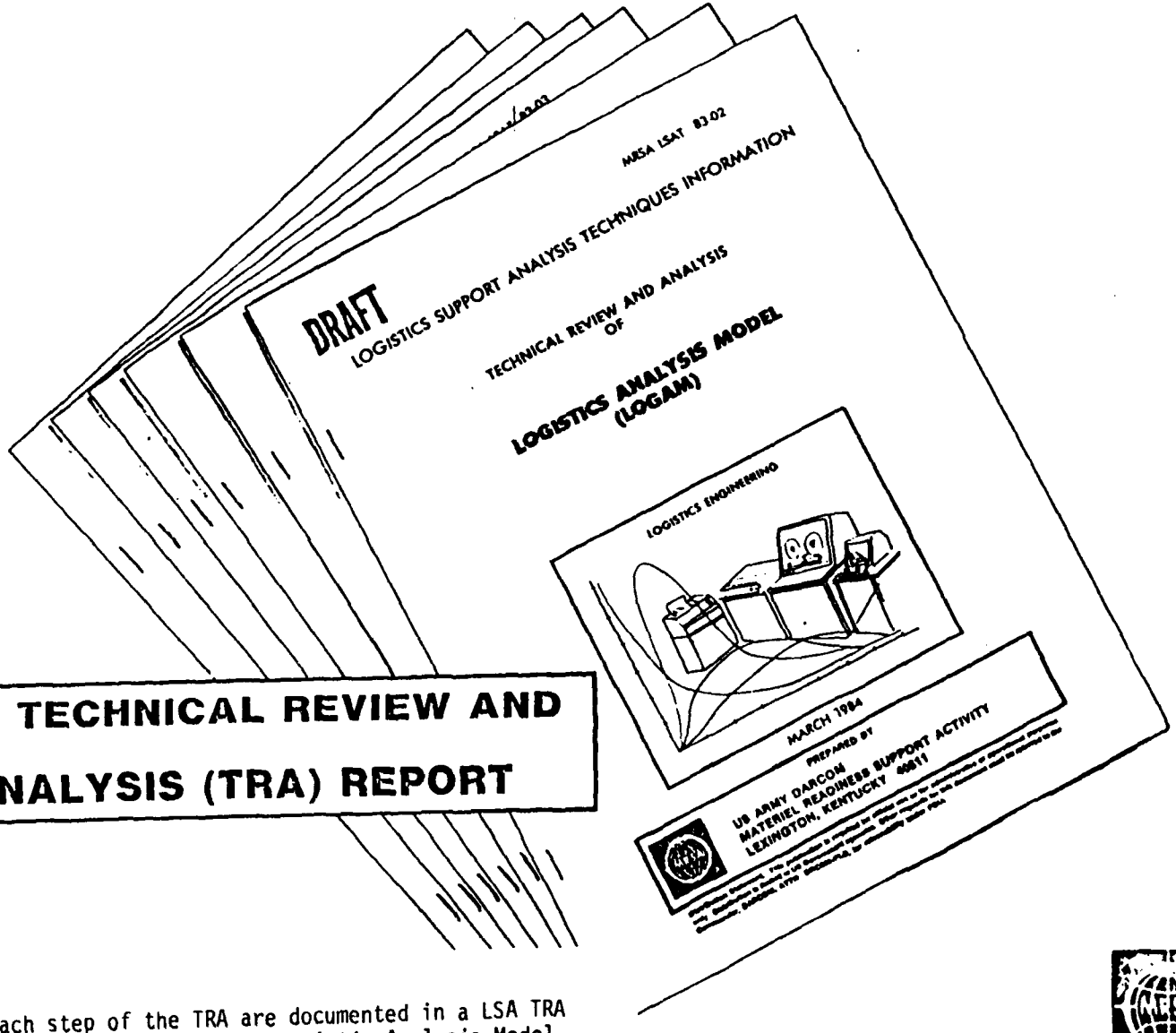
I would like to discuss the methodology MRSA applies to conduct a LSA Technique Technical Review and analysis or TRA, the products of the TRA and the method of documenting the analysis results.



TECHNICAL REVIEW

- APPLICABILITY TO MIL-STD-1388-1A TASKS
- EQUATIONS/CALCULATIONS
- DOCUMENTATION
- INPUT PARAMETERS
- OUTPUT PRODUCTS
- STRENGTHS AND LIMITATIONS
- CONCLUSIONS
- RECOMMENDATIONS

The initial step is to obtain all available documentation e.g., users guide, programmer manual and program tape for evaluation. Then an evaluation is made to determine the applicability of the technique to the LSA tasks and subtasks. Each significant feature of the model is then evaulated to determine accuracy, authenticity and sensitivity and to determine the strengths and limitations. Conclusions and recommendations are then formed based on analysis results.



LSA TECHNICAL REVIEW AND ANALYSIS (TRA) REPORT

The results of each step of the TRA are documented in a LSA TRA report. This is the TRA report on the Logistic Analysis Model or LOGAM. The TRA report is coordinated with the techniqu proponent prior to publication. We now have six TRA reports ready for publication.

Logistic
Support
Analysis

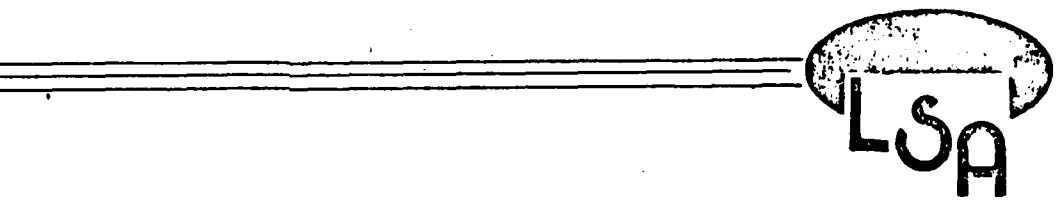
TECHNICAL REVIEW AND ANALYSIS REPORT

END PRODUCTS

- IDENTIFICATION OF APPLICABLE TASKS IN MIL-STD-1388-1A THE TECHNIQUE CAN SATISFY
- DETERMINATION OF CONFORMITY TO REGULATIONS
- DETERMINATION OF RESOURCES REQUIRED TO UTILIZE TECHNIQUE
- DOCUMENT USERS AND POTENTIAL AREAS OF APPLICATION (VARIOUS COMMODITIES)
- ESTABLISH SENSITIVITY OF INPUT DATA AND ANY STANDARD INPUT PARAMETERS
- ANALYSIS OF OUTPUT PRODUCTS AND THEIR USES
- EVALUATE DOCUMENTATION, TRAINING AVAILABILITY AND TRANSPORTABILITY OF THE TECHNIQUE

These are some of the findings within the TRA report that would be of value to a potential user of the technique. The more inportant finding would be the LSA tasks to which the technique could be applied.

Logistic
Support
Analysis



COMPLETED TECHNICAL REVIEW AND ANALYSIS REPORTS

- LOGISTICS ANALYSIS MODEL (LOGAM)
- GENERALIZED ELECTRONICS MAINTENANCE MODEL (GEMM)
- VENTURE EVALUATION REVIEW TECHNIQUE (VERT)
- OPTIMUM REPAIR LEVEL ANALYSIS (ORLA) MICOM VERSION
- COMPUTER-AIDED ESTIMATION OF FAILURE FACTORS
- OBJECTIVE DETERMINATION OF FAILURE FACTORS (DARCOM-P 750-5)

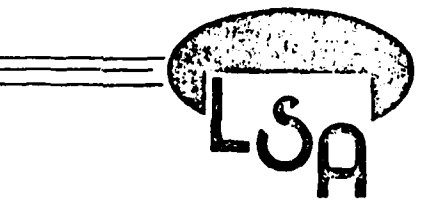
These are the TRA reports that have been completed and will soon be published. The LOGAM TRA report includes an analysis of LOCAM-5 and a comparison of the two similiar models. The VERT TRA report also contains an analysis of intervert, an interactive version of VERT, and a comparison of these two techniques. MRSA has conducted a TRA on eight techniques to date. We have recommended three of the models be recinded and no longer used. (VERT, LOCAM-5, and CAEOFF).

Logistic
Support
Analysis

TECHNIQUE DESCRIPTION

- PURPOSE
- TYPE
- SENSITIVITY FEATURES
  - MULTIPLES
  - DISCRETE STEPS
  - ASSIGNED VALUES
- TYPES OF ANALYSES
  - REPAIR LEVEL
  - REPAIR VS DISCARD
  - MANPOWER AND SUPPORT EQUIPMENT REQUIREMENTS
  - SPARES PROVISIONING
  - LIFE CYCLE COST

Each TRA report contains numerous investigations and finding for each model analyzed. These topics relate to the LOGAM, but are addressed for each technique. The types of analyses investigated may not be limited to that defined in the technique documentation.



STRENGTHS

- WIDELY USED
- TRAINING
- FLEXIBLE INPUT
- RANGE OF ANALYSES
- TRANSPORTABLE
- NON PROPRIETARY
- LIFE CYCLE COST EQUATIONS IAW DA PAM 11-2,3,4
- DOCUMENTATION

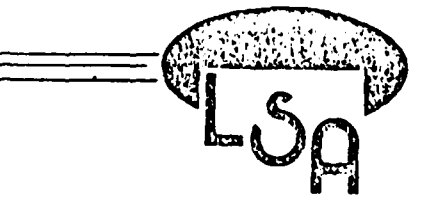
The strengths of each technique are determined during the analysis Again, examples apply to the LOGAM technique.

LIMITATIONS

- ASSUMPTIONS (STEADY STATE, CONSTANT & SYMETRIC DEPLOYMENT)
- ACCURACY OF INPUT DATA
- NO CONTROLLED SUBSTITUTIONS
- AVAILABILITY CALCULATIONS NOT IAW AR 702-3

Limitations or weaknesses of the technique are also determined. These also apply to the LOGAM technique.

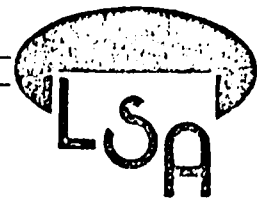
Logistic
Support
Analysis



CONCLUSIONS

- INPUT REQUIREMENTS - APPLICATION DEPENDENT
- AVAILABILITY CALCULATION
- PEACETIME VS WARTIME
- LSA TASK APPLICATIONS
- EXCELLENT DOCUMENTATION
- CONFIGURATION CONTROL
- EXPORTABLE

Conclusions are formed concerning the technique upon completion of the analysis. In the case of LOGAM, the inaccuracies in the availability equation did not significantly affect the outputs.



RECOMMENDATIONS

- REVISE AVAILABILITY CALCULATIONS
- USE FOR LSA TASKS
- ENHANCE OUTPUT FORMAT
- SUPERCEDE LOCAM 5
- OPTIONAL INPUT MODULE

Where appropriate, recommendations are also provided as a result of the analysis. As can be seen, MRSA has recommended that LOGAM-5 be superceded by LOGAM.

Logistic
Support
Analysis

LSA TASK - TECHNIQUE SUMMATION

TASK	NUMBER OF TECHNIQUES
101 DEVELOPMENT OF LSA STRATEGY	3
102 LSA PLAN	4
103 PROGRAM & DESIGN REVIEWS	1
201 USE STUDY	12
202 STANDARDIZATION	19
203 COMPARATIVE ANALYSIS	53
204 TECHNOLOGICAL OPPORTUNITIES	16
205 SUPPORTABILITY DESIGN FACTORS	34
301 FUNCTIONAL REQUIREMENTS IDENTIFICATION	8
302 SUPPORT SYSTEM ALTERNATIVES	20
303 EVALUATION OF ALTERNATIVES & TRADE-OFFS	63
401 TASK ANALYSIS	12
402 EARLY FIELDING ANALYSIS	18
403 I	10
501 1	13

One of the tasks recently completed by MRSA was the comparison of LSA tasks in MIL-STD-1388-1A to the known techniques that could be applied to the tasks. This reflects the results of the task. Readily seen is the proliferation of techniques within the Army. This substanuates the need for a central management activity for LSA techniques.

TECHNICAL REVIEW AND ANALYSIS CANDIDATES
LEVEL OF REPAIR ANALYSIS MODELS

DISCARD/REPAIR COST MODEL	DIREC
REPAIR vs DISCARD MODEL	PALMAN
OPTIMAL SUPPLY AND MAINTENANCE MODEL	OSAMM
NETWORK REPAIR LEVEL ANALYSIS MODEL	NRLA
MARINE CORPS LEVEL OF REPAIR ANALYSIS	MCLOR
LEVEL OF REPAIR (MIL-STD 1390 B)	MOD III LOR

The current interest at the DA and DARCOM is centered on Level of Repair Analysis (LORA) and it is in this area that MRSA will concentrate for the next series of TRA's. There are approximately 25 known LORA techniques. MRSA has initiated TRA action on the six more significant techniques. Shown here.

Logistic
Support
Analysis

LSA

OFF-THE-SHELF ANALYSIS TECHNIQUES UNDER CONSIDERATION

- SUSTAINABILITY PREDICTION FOR ARMY SPARE COMPONENTS (SPARC)
- MEAN TIME BETWEEN REMOVAL (MTBR) CALCULATIONS FROM THE AVSCOM MAINTENANCE OPERATING & SUPPORT COSTS (AMOS) MODEL
- ORACLE-MARC I FAILURE RATE MODEL
- DISCARD/REPAIR COST MODEL (DIREC)
- REPAIR vs DISCARD MODEL (PALMAN)

Another area MRSA, as the LSA Executive Agent, is actively pursueing is that of developing friendly techniques that will be easy to use and execute by unskilled ADP personnel. The objective is to produce techniques that can provide outputs from reference books, tables, graphs and simple desk top calculators. MRSA has started investigation of the PALMAN technique for conversion to off-the-shelf and will consider the others listed here also.

Logistic
Support
Analysis

VALIDATED PARAMETERS LIBRARY

- 31 NON WEAPON SYSTEM PECULIAR LOGISTIC PARAMETERS IDENTIFIED
- COMMON PARAMETERS INCLUDE
  - MILITARY/CIVILIAN LABOR COSTS
  - PERSONNEL ATTRITION/TURNOVER RATES
  - ORDER/SHIP TIMES
  - COST RETAIN ITEM IN SUPPLY SYSTEM
  - SHIPPING COST/LB
  - TRAINING COSTS
  - TECH PUBS COSTS

50

Another task in which MRSA has initiated actions is that of establishing a library of non weapon system peculiar input parameters. The standardized input paramters will be used as inputs to appropriate techniques. 31 parameters have been identified to date.

Logistic
Support
Analysis

LOGISTIC SUPPORT ANALYSIS TECHNICAL WORKING GROUP (LSA-TWG)

An LSA Technical Working Group has also been established to assist in standardizing the LSA techniques within the Army and to provide assistance to technique users.

Logistic
Support
Analysis

LSA-TWG

PURPOSE

- PROVIDE TECHNICAL DIRECTION FOR LSA ENHANCEMENT EFFORTS
- ESTABLISH A FORMAL PROCESS FOR ENHANCEMENT OF LSA EXPERTISE WITHIN EACH MSC

ORGANIZATION

- MRSA SERVES AS CHAIRPERSON
- MSC/ANALYSIS ACTIVITY PROVIDES ONE OR MORE MEMBERS

These are the two main purposes of the LSA-TWG. MRSA, as the LSA Executive Agent, serves as chairman.

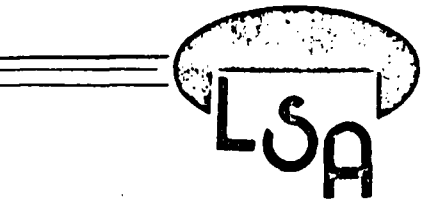
Logistic
Support
Analysis

LSA EXECUTIVE AGENT ACTIONS

- MAJOR FUNCTIONS (DOCUMENTED 5 YR PLAN)
- LSA TECHNIQUES GUIDE (APR 84 PUBLICATION)
- LIBRARY OF TECHNIQUES IN GUIDE (OVER 80 MODELS CATALOGED)
- LSA TECHNIQUES ANALYSIS (9 MODELS ANALYZED IN DEPTH)
- COORDINATE/ASSIST IN LSA ENHANCEMENT EFFORT WITHIN MSC's (LSA-TWG ESTABLISHED)
- BRIDGING LSA REQUIREMENTS AND CURRENT TECHNIQUES (IDENTIFIED VOIDS)
- VALIDATED PARAMETERS LIBRARY (IDENTIFIED SOME COMMON PARAMETERS)
- OFF-THE-SHELF ANALYSIS TECHNIQUES (CANDIDATE TECHNIQUES SELECTED)

These are some of the major actions at MRSA with respect to LSA techniques that have been addressed. Many have already been initiated.

Logistic
Support
Analysis



REQUESTS FOR INFORMATION

COMMANDER US ARMY DARCOM

MATERIEL READINESS SUPPORT ACTIVITY

ATTN: DRXMD-EL

LEXINGTON, KENTUCKY 40511

AUTOVON 745-3985

COMMERCIAL (606) 293-3985

This completes the MRSA presentation on LSA techniques and TRA's. If we at MRSA may be of assistance to you or if you desire copies of our TRA's, this is our address. Thank you for the opportunity of sharing some of MRSA's activities with you.

LOGISTICS OPERATIONAL EFFECTIVENESS NETWORK ANALYSIS

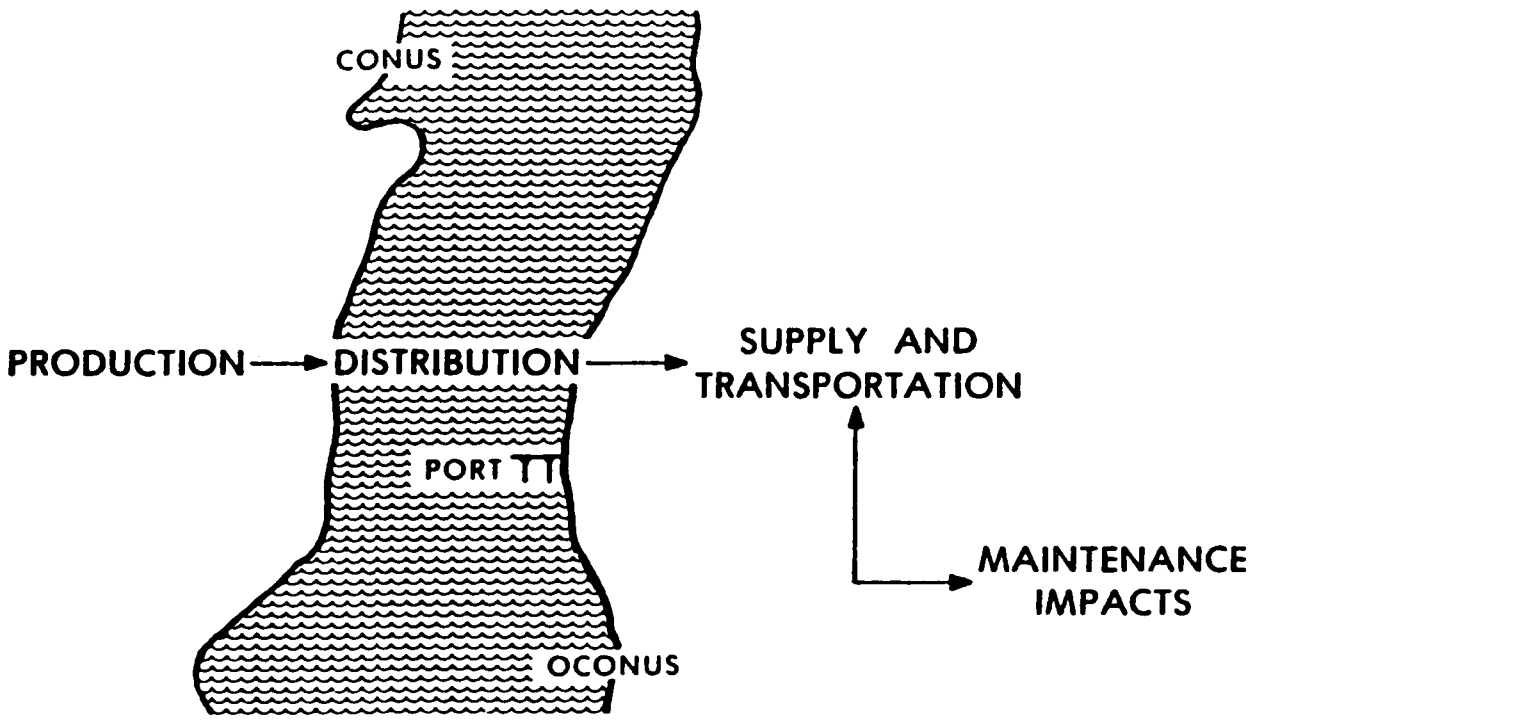
Maureen Stark
US Army Ballistic Research Laboratory

LOGISTICS OPERATIONAL EFFECTIVENESS ANALYSES

MAUREEN M. STARK

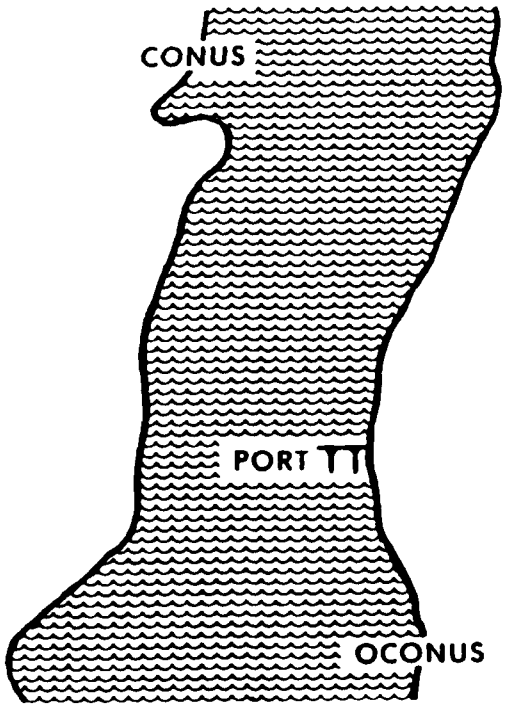
Radiation/Engineering Branch
Vulnerability/Lethality Division
Ballistic Research Laboratory

LOGISTICS MODELS / ANALYSES



SEP 83

EFFECTIVENESS MODELS / ANALYSES



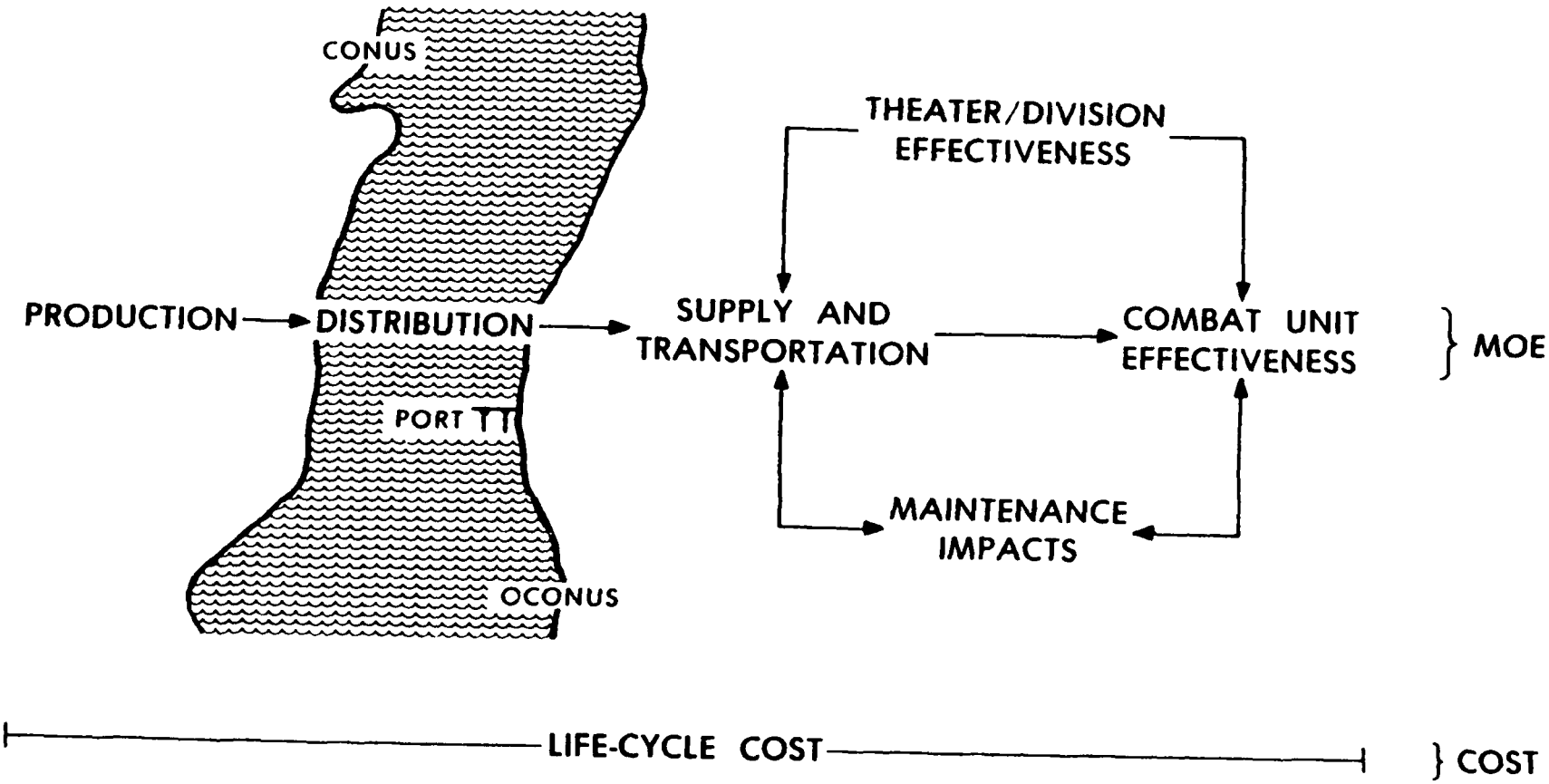
THEATER/DIVISION EFFECTIVENESS

COMBAT UNIT EFFECTIVENESS

MAINTENANCE IMPACTS

SEP 83

OPERATIONAL EFFECTIVENESS ANALYSIS NETWORK



SEP 83

INITIAL APPLICATION

LIQUID PROPELLANT GUN (LPG) AREA

09

SEP 83

ANTICIPATED ADVANTAGES OF LPG

- IMPROVED FIRING RATE
- ELIMINATES CHARGE SELECTION ERROR
- INCREASED FIRING RANGE
- TRAJECTORY FLEXIBILITY
- REDUCED MUZZLE FLASH/BLAST

- REDUCED CREW SIZE
- REDUCED VULNERABILITY

- IMPROVED SAFETY
- REDUCED TRAINING REQUIREMENTS
- LONGER TUBE LIFE
- REDUCED RESUPPLY REQUIREMENTS
  TRANSPORTATION, HANDLING AND STORAGE
- REDUCED PACKAGING/PRODUCTION COSTS
- SIMPLIFIED DEMILITARIZATION

SEP 83

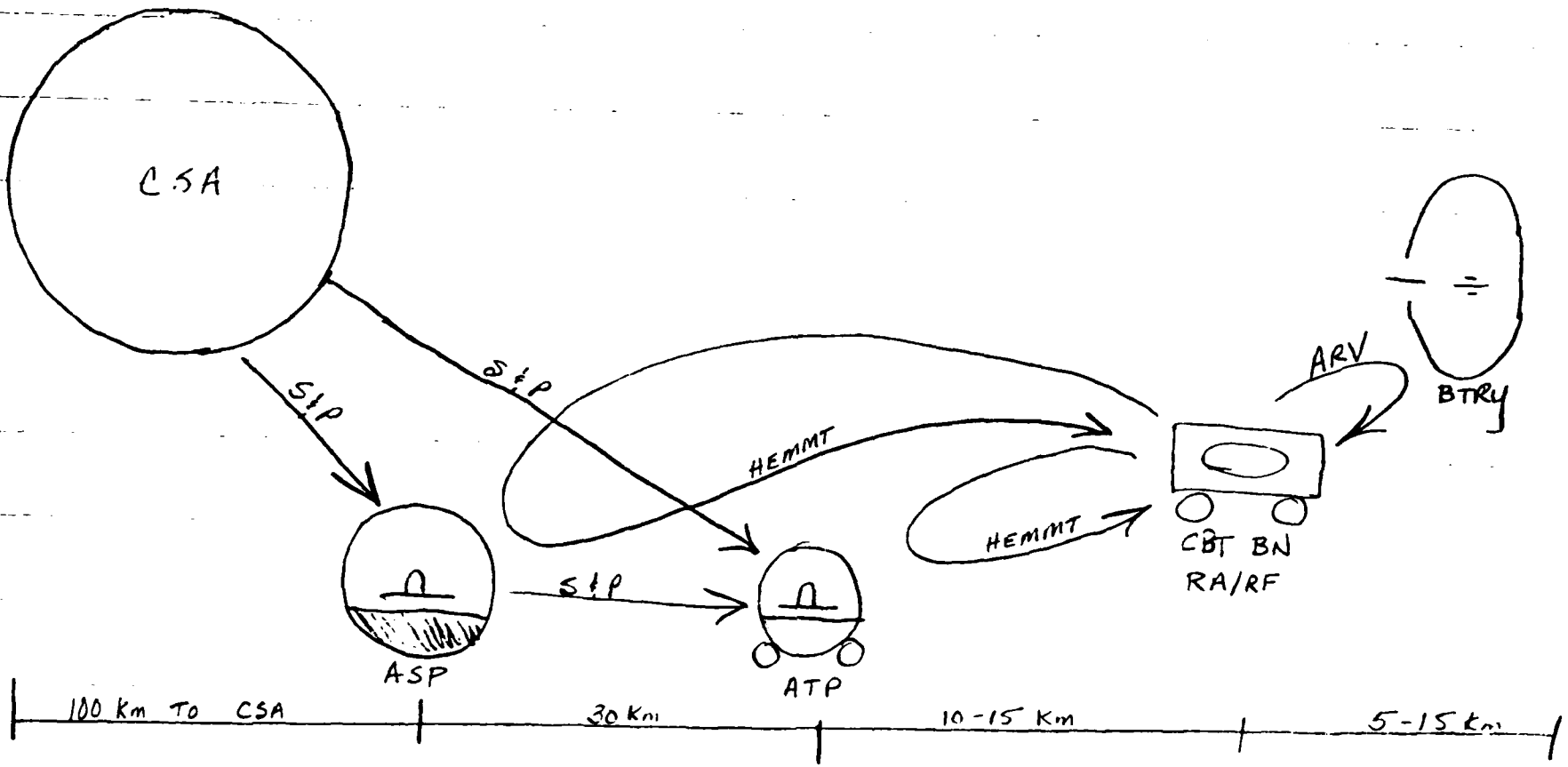
POTENTIAL ISSUES

- IMPROVED FIRING RATES MAY REQUIRE INCREASED RESUPPLY
- REDUCED VULNERABILITY WILL REDUCE CATASTROPHIC KILLS BUT MAY INCREASE SYSTEMS REQUIRING REPAIR
- AUTOMATIC LOADING MAY INCREASE THE COMPLEXITY AND VULNERABILITY OF SPECIFIC COMPONENTS
- REDUCED CREW SIZE MAY ALSO REDUCE ABILITY OF CREW TO INTERNALLY RECONSTITUTE
- REDUCED RESUPPLY REQUIREMENTS COULD BE OBVIATED BY THE NECESSITY FOR ADDITIONAL RESUPPLY EQUIPMENT/VEHICLES
- DOES REDUCED PACKAGING/PRODUCTION COSTS TRANSLATE TO REDUCED LIFE-CYCLE COSTS ?

BOTTOM LINE: THIS PROGRAM WILL IDENTIFY, EVALUATE AND PROVIDE INSIGHTS INTO ISSUES OF THIS TYPE

SEP 83

AMMUNITION RESUPPLY SYSTEM



SUPPLY POINT ANALYSIS

- HOLD STOCKAGE LEVELS CONSTANT (NO. OF ROUNDS)
- USE TONNAGES TO COMPUTE AND COMPARE
  - MHE REQUIREMENTS
  - PERSONNEL REQUIREMENTS
  - TRAILER REQUIREMENT (ATP)

PROPELLANT PACKAGING

SOLID

BAG, MODULAR } CURRENT PALLET CONFIGURATION

UNI-CHARGE OPTIMIZED PALLET CONFIGURATION

LIQUID

55-GALLON DRUMS/4 PER PALLET

15-GALLON DRUMS/12 PER PALLET

500 GALLON BLADDERS/NO PALLET*

500 GALLON BLADDERS & 10000 GALLON FABRIC TANKS*

* WOULD UTILIZE FILTERS AND PUMPS REDUCING THE REQUIREMENT FOR MHE

ASP/ATP RESULTS

		BAG	MODULAR	UNI-CHG	55G DRUM	500G BLADDER
REQUI	FORKLIFTS	6	6	5	3	0
	PERSONNEL	20	20	15	10	4(1)
	TRAILERS(2)	4	4	2	1	1
SAVED	FORKLIFTS	0	0	1	3	6
	PERSONNEL	0	0	5	10	16
	TRAILERS(2)	0	0	2	3	3

(1) PUMP PERSONNEL

(2) ATP TRAILERS

TRANSPORTATION ANALYSIS

APPROACH

- DETERMINE FOR EACH PROPELLANT CONCEPT:
  - MAXIMUM LOADS FOR RESUPPLY VEHICLES
  - NUMBER OF TRIPS/MAN HOURS REQUIRED TO SUPPORT GIVEN DEMAND RATES

TRANSPORTATION SUMMARY

SAVINGS

			CONCEPT				
			BAG	MODULAR	UNI-CHG	55G DRUM	500G BLADDER
180 RD/TUBE/DA		PERSONNEL	0	0	2	5	5
		TRUCKS	0	0	4	15	16
360 RDS/TUBE/DAY		PERSONNEL	0	1	4	14	15
		TRUCKS	0	2	9	32	35

TOTAL POTENTIAL DIVISION SAVINGS

- o 100-300 PERSONNEL
- o 40-80 FORKLIFTS/TRUCKS

BLADDER (BULK) CONCEPT PROVIDES
GREATEST SAVINGS

IMPLEMENTATION ISSUES

WHEN IS TECHNOLOGY MATURE ENOUGH ?

- EARLY APPL. SUFFERS FROM INSUFFICIENT DATA
- LATE APPL. SUFFERS FROM MOMENTUM OF PREVIOUS DECISIONS

LEVEL OF DETAIL

- HOW TO QUANTIFY ?
- WHAT LEVEL IS REQUIRED ?
- WHAT KIND OF DATA IS REQUIRED ?

INTERFACE OF VARIOUS ANALYSES

- DIFFERENT ASSUMPTIONS
- DIFFERENT PARAMETERS

GENERIC

- DEVELOP METHODOLOGY OR ANALYSTS ?

FORECASTING PERFORMANCE FOR SLOW MOVING ITEMS

Robert Deemer
Army Materiel Systems Analysis Activity
Inventory Research Office

FORECASTING PERFORMANCE FOR SLOW MOVING ITEMS

ROBERT DEEMER/ALAN KAPLAN

MAY 1984

ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY

INVENTORY RESEARCH OFFICE, PHILA., PA

BACKGROUND

- SEPTEMBER 1978 ARMY BEGAN ANALYSIS OF DOD SUGGESTED STOCKAGE POLICY (RETAIL INVENTORY MANAGEMENT AND STOCKAGE POLICY - RIMSTOP)

- POLICY DESIGNED SO CAN PROJECT WHAT WILL HAPPEN WHEN BUDGET CUTS ARE MADE

- IMPLEMENTED IN SAILS-ABX JAN 82 AND DSISS MAR 82 (DS4 TO BE IMPLEMENTED)

- REPORTS OF IMPLEMENTED SYSTEMS INDICATE MORE ITEMS NOW BEING STOCKED AT REDUCED DEPTH

- REPORTS ALSO INDICATE ACTUAL PERFORMANCE IS MUCH LOWER THAN PROJECTED

PROBLEM

- OVERALL: STOCKAGE POLICY AT ARMY RETAIL LEVEL OF SUPPLY
- SPECIFIC:
  - ONE YEAR DATA BASE (TRUNCATED)
  - MANY ITEMS WITH FEW REQUISITIONS
  - TO PROJECT STOCKAGE PERFORMANCE FOR NEXT YEAR

PERFORMANCE

- INITIAL FILL - FRACTION OF ALL REQUISITIONS WHICH ARE FILLED FROM STOCK ON-HAND

- SATISFACTION - FRACTION OF REQUISITIONS FOR STOCKED ITEMS FILLED FROM STOCK ON-HAND

- ACCOMMODATION - FRACTION OF REQUISITONS FOR STOCKED ITEMS

****

SAILS-ABX DATA

THEORETICAL PROJECTIONS	ACCOMMODATION = .65
	SATISFACTION = .86
ACTUAL	ACCOMMODATION = .29
	SATISFACTION = .61

DATA:

NUMBER OF ITEMS
CUMULATIVE PROBABILITIES

# REQUISITIONS	SAILS-ABX	DSISS	DLOGS/DS4
1	.352	.687	.438
2	.621	.826	.598
3	.726	.881	.68[illegible]
4	.787	.909	.742
5	.829	.928	.779
6	.864	.940	.809
7	.884	.949	.831
8	.905	.956	.846
9	.919	.962	.859
10	.928	.967	.870
11-15	.957	.980	.906
16-25	.979	.988	.940
>25	1.000	1.000	1.000
# OBSERVATIONS	5003	26294	27298

2 YEAR REQUISITION HISTORY

SAILS-ABX			DLOGS		
# REQN YEAR 1	# REQN YEAR 2	AVG REQN YEAR 2	# REQN YEAR 1	# REQN YEAR 2	AVG REQN YEAR 2
0	10925 (22)	2.38	0	35439 (13)	1.61
1	2174	.72	1	11833	.85
2	1925	1.35	2	8904	1.70
3	1365	2.15	3	7107	2.47
4	1321	3.18	4	6118	3.35
5	1259	4.51	5	5768	4.75
6	1044	4.88	6	5203	5.34
7	1052	6.15	7	3927	5.71
8	937	7.26	8	3233	6.51
9	990	6.83	9	3193	7.60
10	843	7.33	10	2734	7.68
11	687	8.18	11	2822	9.63
12	767	8.82	12	2514	10.70
13	841	11.07	13	2480	10.42
14	925	11.28	14	2446	13.44
15	590	10.73	15	2336	12.49
18	589	10.91	16-20	9009	14.84
22	757	15.14	21-25	7544	17.63
>24	15368	40.44	>25	140812	79.24
TOTAL	48749			263422	

SOLUTION ATTEMPTS

METHOD I

- TRUNCATED NEGATIVE BINOMIAL DISTRIBUTION (BARTKO - VJS 1961)
- USE METHOD OF MOMENTS TO GET PARAMETERS
- INVOLVES RATIO OF

  NUMBER OF ITEMS WITH ONE REQUISITION

  TO

  TOTAL NUMBER OF ITEMS

METHOD I - RESULTS

- DEVELOPED NEGATIVE PARAMETER (K) VALUE
- RELATIONSHIP OF N1/N TOO LARGE W. R. T.

  VARIANCE OF DISTRIBUTION

DLOGS DATA

PROBABILITIES OF # ITEMS

# REQN	ACTUAL	A. CUMULATIVE	THEORETICAL	T. CUMULATIVE
1	.4377	.4377	.2968	.2968
2	.1598	.5975	.1511	.4479
3	.0884	.6859	.0960	.5439
4	.0561	.7420	.0696	.6135
5	.0369	.7789	.0536	.6671
6	.0300	.8089	.0429	.7099
7	.0216	.8305	.0352	.7451
8	.0152	.8457	.0294	.7745
9	.0128	.8585	.0250	.7995
10	.0110	.8695	.0214	.8209
11-15	.0369	.9064	.0717	.8926
16-20	.0198	.9262	.0392	.9318
21-25	.0140	.9402	.0231	.9549
>25	.0599	1.0000	.0451	1.0000

$M = 1.71$

$\sigma^2 = 29.27$

SOLUTION ATTEMPT

METHOD II

SEARCH PROCEDURE FOR PARAMETERS (N.B.D.)

USE RELATIONSHIPS:

$$m = (1-Po)\ Et\ (x)$$

$$S^2 = (1-Po)\ Et\ (x^2) - (1-Po)\ Et\ (x)^2$$

A. SET $\hat{Po}$

B. EVALUATE ABOVE EQUATIONS

C. DETERMINE $\bar{w}$, $\bar{k}$

D. COMPUTE $Po\ (\bar{w},\bar{k})$

E. $\bar{w},\bar{k}$ CHOSEN SO THAT

$$|\hat{Po} - Po| = \text{MINIMUM}$$

METHOD II - RESULTS (SAILS-ABX DATA)

- CONVERGES TO REALISTIC NBD PARAMETERS
- THEORETICAL PERFORMANCE IS CONSIDERABLY LOWER BUT STILL NOT LOW ENOUGH
  - ACCOMMODATION = .46
  - SATISFACTION = .85

METHOD II - RESULTS (SAILS-ABX DATA)

Po (SET)	Po (DERIVED)	w	k
.05	1.4847	.0619	-.1421
.10	1.4407	.0642	-.1329
.15	1.3932	.0667	-.1225
.20	1.3422	.0696	-.1104
.25	1.2875	.0729	-.0965
.30	1.2288	.0768	-.0803
.35	1.1659	.0813	-.0612
.40	1.0985	.0866	-.0384
.45	1.0263	.0929	-.0109
.50	.9490	.1006	.0227
.55	.8663	.1100	.0650
.60	.7777	.1218	.1184
.65*	.6830	.1371	.1919
.70	.5819	.1575	.2929
.75	.4745	.1862	.4434
.80	.3616	.2293	.6908
.85	.2452	.3013	1.1718
.90	.1313	.4455	2.5108
.95	.0361	.0785	25.6261

METHOD II - RESULTS

(DLOGS/DS4 DATA)

- CONVERGENCE DOES NOT YIELD APPROPRIATE VALUES
- PROJECTIONS OF NUMBER OF REQUISITIONS IS NOT VERY GOOD

ACTUAL REQN IN YEAR 2 WHICH HAD ZERO IN YEAR 1	PROJECTED REQN IN YEAR 2
35439	13748

METHOD II - RESULTS (DLOGS/DS4 DATA)

Po (SET)	Po (DERIVED)	$\bar{w}$	$\bar{k}$
.05	10.4891	.0032	-.4095
.10	10.1826	.0034	-.4080
.15	9.8642	.0036	-.4063
.20	9.5329	.0038	-.4044
.25	9.1874	.0040	-.4023
.30	8.8262	.0043	-.3998
.35	8.4475	.0046	-.3970
.40	8.0491	.0050	-.3937
.45	7.6285	.0054	-.3898
.50	7.1824	.0060	-.3851
.55	6.7071	.0066	-.3793
.60	6.1974	.0074	-.3721
.65	5.6469	.0085	-.3629
.70	5.0471	.0099	-.3505
.75	4.3863	.0118	-.3331
.80	3.6482	.0147	-.3068
.85	2.8103	.0196	-.2627
.90	1.8431	.0293	-.1732
.95	.7392	.0585	.1064

METHOD III

- KEEP NBD AS DISTRIBUTION
- USE RECURSIVE RELATIONSHIP OF NBD

$$F(I) = \left(\frac{R+I-1}{I}\right) \quad Q \quad F(I-1)$$

- USE THIS RELATIONSHIP IN FORM

$$\frac{IF(I)}{F(I-1)} = RQ + Q\ (I-1)$$

WHICH IS OF LINEAR FORM

$$Y = A + BX$$

METHOD III

- GET A,B VIA LINEAR REGRESSION

  WHERE KNOW I, F(I), F(I-1) FROM DATA

- NOT ACCEPTABLE RESULTS

  - NEGATIVE INTERCEPT (A) VALUE FOR DLOGS DATA

METHOD III - REVISED

- WEIGHTED LINEAR REGRESSION

- WEIGHTS ARE

$$\frac{\frac{N(I) + N(I-1)}{2}}{I^2} \qquad I = 2,\ldots,10$$

PROJECTION OF NUMBER OF REQUISITIONS IS NOT VERY GOOD

ACTUAL REQN IN YEAR 2 WHICH HAD ZERO IN YEAR 1	PROJECTED REQN IN YEAR 2
35439	11301

OTHER ATTEMPTS

- PLOT OF REQUISITIONS LOOKS LIKE EXPONENTIAL DISTRIBUTION
- TRIED GEOMETRIC
  - DOESN'T ACCOUNT FOR VARIANCE SUFFICIENTLY
  - ACTUAL DISTRIBUTION MUCH MORE SKEWED
  - PROJECTION OF NUMBER OF REQUISITIONS IS NOT VERY GOOD

ACTUAL REQN IN YEAR 2 WHICH HAD ZERO IN YEAR 1	PROJECTED REQN IN YEAR 2
35439	33 52

SUPPORTING THE FUTURE FORCE

J. Russell Wiltshire
HQ
Department of the Army

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SUPPORTING THE FUTURE FORCE

DR. J. RUSSELL WILTSHIRE

ARMY RESEARCH OFFICE

LOGISTICS R&D WORKSHOP

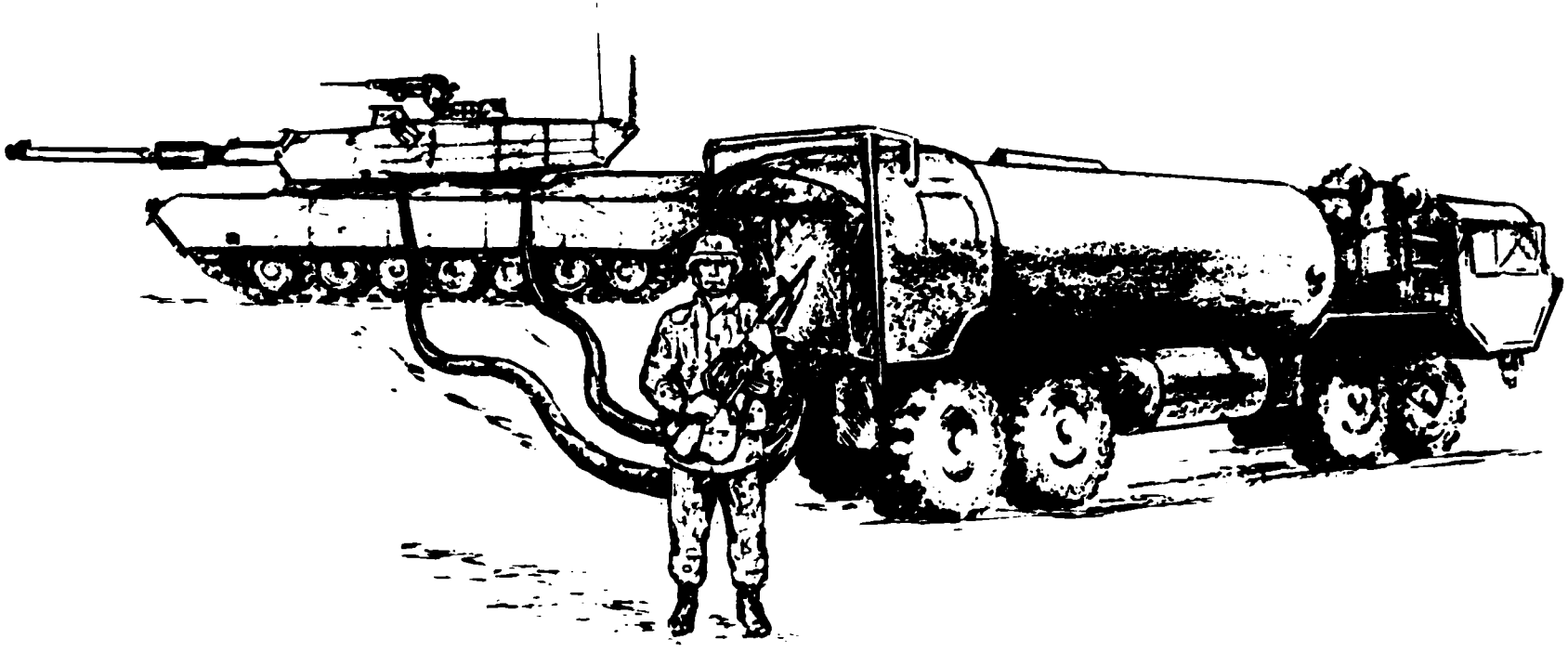
8 MAY 1984

SLIDE 1 ON --"DCSLOG"

- GOOD AFTERNOON LADIES AND GENTLEMEN
  - PLEASURE TO ADDRESS: ARMY RESEARCH OFFICE LOGISTICS AND R&D WORKSHOP
- ARMY PLACING CONSIDERABLE EMPHASIS ON R&D TO REDUCE SUPPORT AND LOGISTICS REQUIREMENTS.
- GIVEN TIME - LENGTH AND COST OF R&D, YOUR INTEREST IN LOG R&D IS MOST WELCOME.
- IT SHOULD BE NO SURPRISE TO YOU THAT "WEAPONS" CREATE MORE INTEREST THAN "LOGISTICS." LET ME CITE A SINGLE EXAMPLE OF WHAT CAN HAPPEN WHEN WEAPON DEVELOPERS LOSE SIGHT OF THE LOGISTICAL IMPACT OF THEIR DECISIONS.

SLIDE 1 OFF

REFUELING OPERATIONS - M1 TANK



SLIDE 2 ON -- M1 TANK BEING REFUELED.

- o M1 TANK - EXCELLENT ARMORED VEHICLE - EASY TO OPERATE, ADVANCED ARMOR, HIGH SPEED, LASER AIMING, SINGLE SHOT ACCURACY.
- o IT ALSO USES 60 PERCENT MORE FUEL THAN THE TANK IT REPLACES.
  - oo RESULT: INCREASE IN NUMBER OF SUPPORTING FUEL TRUCKS, ADDITIONAL DRIVERS, MORE TRANSPORT - RELATED MAINTENANCE AND PARTS.
  - oo INCREASED TRAFFIC ON ROADNET, MORE FUEL TO BE DELIVERED TO THEATER, BOTH FOR TANK AND THE EXTRA FUEL TRUCKS.
- o IT IS REFUELED BY GRAVITY FUEL SYSTEM - JUST LIKE THE FAMILY CAR.
  - oo THIN-SKINED, WHEELED FUEL TRUCKS, WHICH CAN BE DESTROYED BY SINGLE TRACER BULLET.
  - oo FUEL TRUCKS HAVE A LIMITED CROSS-COUNTRY MOBILITY - TANKS MUST DISENGAGE, PULL TO ROADSIDE.
  - oo TRUCKS DRIVER MUST DISMOUNT - CONNECT FUEL HOSES - TAKES UP TO 40 MINUTES.
- o IT IS RE-ARMED IN THE SAME WAY.
  - oo THIN-SKINED, UNARMORED, WHEELED AMMUNITIION VEHICLES.
  - oo TANK MUST HALT - 1 ROUND AT A TIME THROUGH TOP OF TURRET.
  - oo CREW EXPOSED TO ELEMENTS - AND SMALL ARMS FIRE.
  - oo FULL RELOAD - 50 ROUNDS - 1 AT A TIME: 40 MINUTES.
- o IN SHORT - THE BEST TANK IN THE WORLD ON THE SECOND DAY OF BATTLE WILL BECOME A PAPER WEIGHT - IF THE LOGISTIC SYSTEM CANNOT PROVIDE IT WITH FUEL AND AMMUNITION.

(CONTINUED NEXT PAGE)

WE ARE WORKING ON THESE PROBLEMS (E.G., PRESSURIZED RE-FUEL SYSTEM; ARMORED FORWARD AREA RE-ARM VEHICLE), BUT THEY REQUIRE R&D, AND SOLUTION IS YEARS AWAY.

oo TODAYS LOGISTICS SYSTEM IS INCAPABLE OF PROVIDING ADEQUATE SUPPORT FOR THE TYPE OF COMBAT ENVISIONED FOR THE TWENTY-FIRST CENTURY.

o THAT IS THE THEME OF MY TALK, THIS (AM PM) _____ - "SUPPORTING THE FUTURE FORCE."

SLIDE 2 OFF

LIEUTENANT GENERAL JAMES M. GAVIN

"ORGANIZATIONS CREATED TO FIGHT THE LAST WAR BETTER ARE NOT GOING TO WIN THE NEXT."

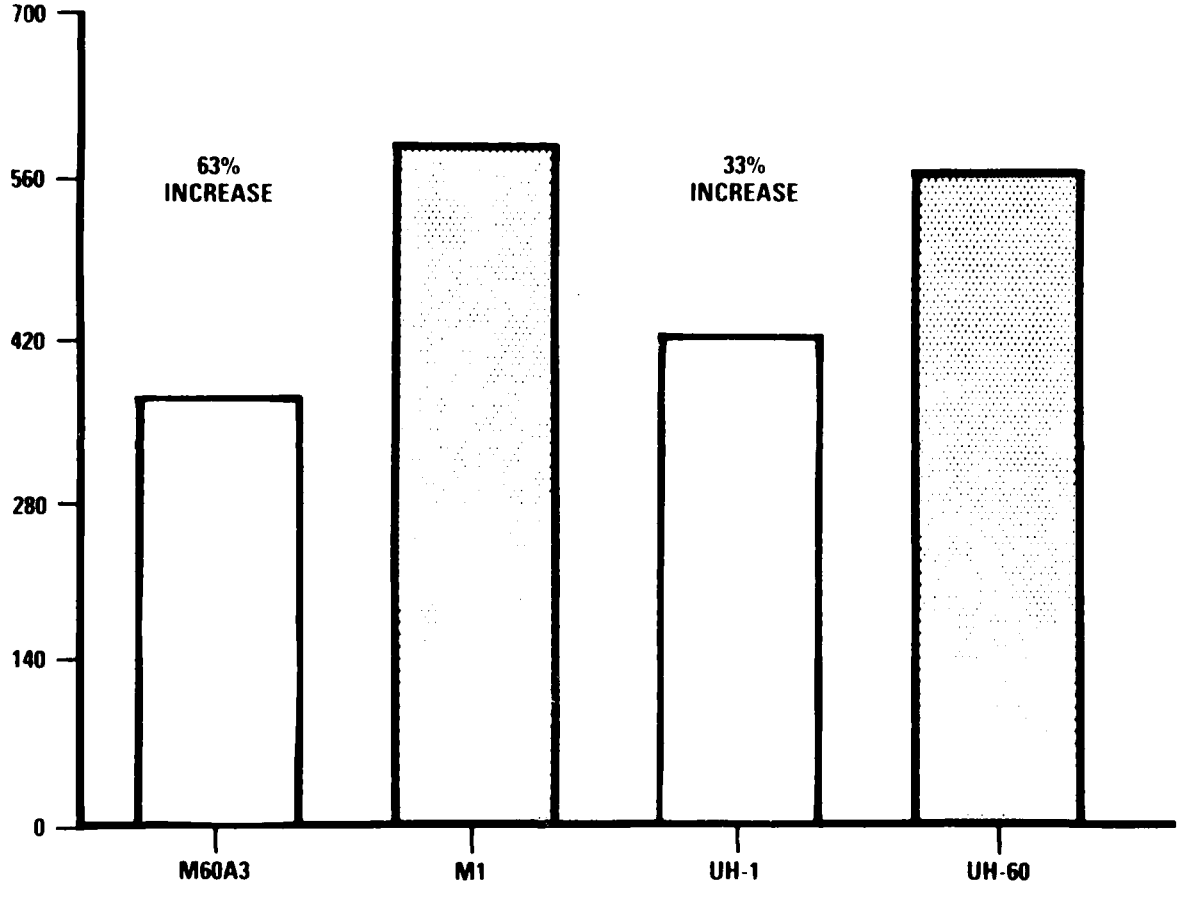
SLIDE 3 ON

GAVIN QUOTE

- o MOREOVER, WE CAN'T PLAN TO FIGHT OR SUPPORT THE NEXT WAR THE WAY WE DID VIETNAM - OR EVEN THE OPERATION IN GERNADA.
  - oo VIET NAM-LONG DURATION, IMMENSE STOCKPILES; LONG LEAD TIMES; MANPOWER INTENSIVE; PUSH SYSTEM OF SUPPLIES; RAPID TURNOVER OF PERSONNEL MADE IT A SERIES OF "ONE YEAR WARS."
  - oo GRENADA - VERY SHORT COMBAT OPERATION; NOT INTENSE COMBAT; LITTLE SUSTAINMENT REQUIRED; DEPENDENT ON ACCOMPANYING SUPPLIES; LITTLE DEMAND ON WHOLESALE SYSTEM; REPLENISHMENT AIRLIFTED FROM CONUS.
- o WE MUST FIND IMPROVED OR NEW WAYS TO DO THE JOB.
- o THE NEXT COUPLE OF SLIDES WILL GIVE YOU SOME CONCEPT OF THE MAGNITUDE OF THE PROBLEM FACING US TODAY.

SLIDE 3 OFF

FUEL CONSUMPTION IN A DAY OF COMBAT



- ARMOR DIVISION OF 348 TANKS CONSUMES IN 1 DAY OF COMBAT
  - 121,000 GAL. FUEL (M60)
  - 203,580 GAL. FUEL (M1)

SLIDE 4 ON

FUEL CONSUMPTION

- o FUEL CONSUMPTION IS A MAJOR PROBLEM.
- o NEW EQUIPMENT TYPICALLY USES MORE FUEL THAN THAT WHICH IT REPLACES.
- o TWO EXAMPLES--
  - oo M1 TANK USES 63 PERCENT MORE FUEL THAN THE M60A3.
  - oo UH-60 HELICOPTER USES A THIRD MORE THAN THE UH-1.
- o AN ARMOR DIVISION IN 10-20 DAYS OF COMBAT CONSUMES AS MUCH FUEL AS IT DOES IN A YEAR OF TRAINING.
- o AN ARMOR DIVISION EQUIPPED WITH
  - oo M-60S USES 121,000 GAL FUEL PER DAY.
  - oo M-1S USES 203,000 GAL FUEL PER DAY.

- o WE ARE TRYING TO DEVELOP MORE FUEL-EFFICIENT ENGINES. THE ADIABATIC ENGINE - NOW BEING TESTED AT TACOM - HOLDS GREAT PROMISE. THE TEST ENGINE IS INSTALLED IN A 5 TON TRUCK, HAS NO RADIATOR OR COOLING SYSTEM, AND PROMISES 20% DECREASE IN FUEL CONSUMPTION WHILE INCREASING POWER BY ABOUT 30%.
  - oo PROVIDE ALTERNATIVE SOURCES OF POWER (E.G., PONY ENGINE FOR M-1 TANK).
  - oo PROVIDE MORE FUEL TRUCKS - 7,500 GAL TANKER.
- o FUEL IS NOT THE ONLY PROBLEM

SLIDE 4 OFF

THREE DAYS OF SUPPLY

MECHANIZED INFANTRY BRIGADE

TOTAL NUMBER TRUCKS REQUIRED

DRY CARGO (STON) — 4,012 = 802 VEHICLES

WET CARGO (GAL) — 536,555 = 180 TANKERS*

LENGTH OF CONVOY ON MOVE — 59 MILES!

TIME TO PASS A GIVEN POINT — 3+ HOURS!

LENGTH OF CONVOY (BUMPER TO BUMPER) — 4 MILES!

*LOAD TO 3,000 GAL. FOR CROSS COUNTRY

NON-SURVIVABLE UNDER ARMY 21

GROUND RULES

1. 72 HOURS WORTH
2. MECH INF BDE ≅ ARMY 21 REGT
3. NO RESTRICTIONS ON LOAD MIX
4. ASSUME 80% AVAILABILITY RATE FOR VEHICLES
5. USE CURRENT PLANNING FACTORS FM 101-10-1, ETC.
6. GRAVEL ROAD
7. 5-TON VEHICLES
8. NO MAJOR ITEM RESUPPLY

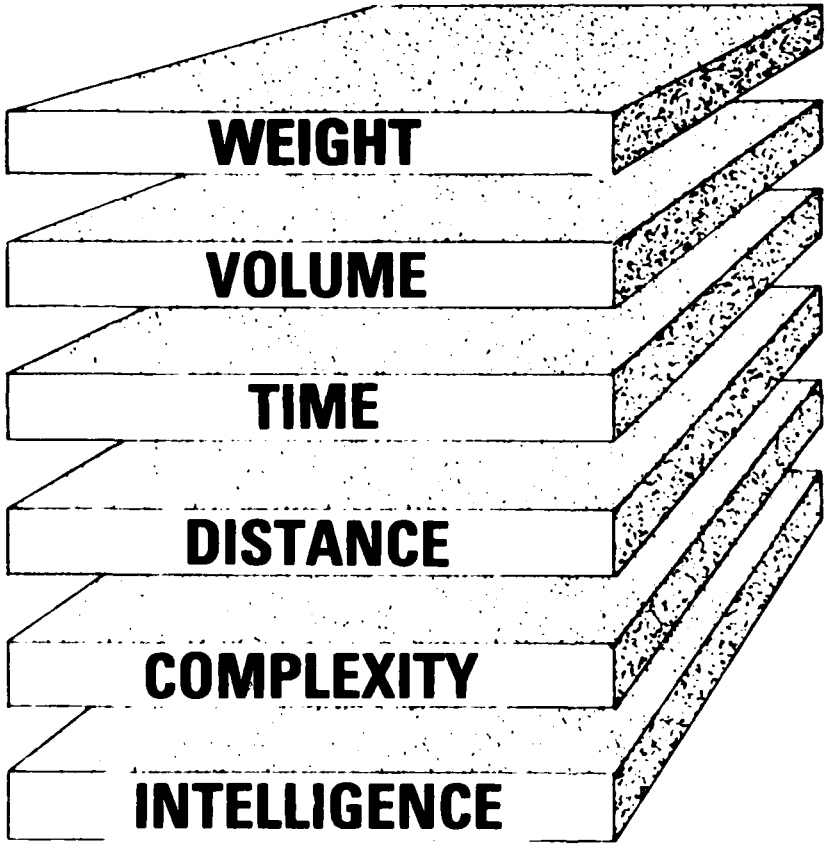
SLIDE 5 ON

THREE DAYS OF SUPPLY

- o WHEN YOU LOOK AT THE REQUIREMENTS FOR A THREE-DAY OPERATION BY A SINGLE MECHANIZED INFANTRY BRIGADE,
  - oo USING CURRENT EQUIPMENT, EMPLOYED UNDER THE ARMY 21 CONCEPT.
- o IT WOULD TAKE AT LEAST:
  - oo 802 5 TON TRUCK LOADS OF DRY CARGO.
  - oo 180 3,000 GAL TANKER LOADS OF FUEL AND WATER.
  - oo 1000 DRIVERS AND SUPERVISORY PERSONNEL
- o IF AVAILABLE TO SUPPORT THE BRIGADE, THESE VEHICLES WOULD MAKE A MARCH COLUMN
  - oo THAT WAS 59 MILES LONG.
  - oo WOULD TAKE 3 HOURS TO PASS A SINGLE POINT
- o CONCLUSION: THE INESCAPABLE CONCLUSION IS THAT A CURRENT MECH INF BRIGADE WOULD NOT BE SUPPORTABLE UNDER CONDITIONS ENVISIONED FOR THE ARMY'S FUTURE WARFIGHTING CONCEPT, ARMY 21 (FORMERLY AIRLAND BATTLE 2000).
- o WE MUST FIND WAYS TO:
  - oo LESSEN THE REQUIREMENT - SO WE HAVE TO PROVIDE LESS.
  - oo INCREASE THE EFFICIENCY OF THE LOGISTICS SYSTEM - SO WE CAN PROVIDE MORE WITH FEWER PEOPLE AND VEHICLES.
- o ONE ASPECT OF THE SOLUTION IS TO "LIGHTEN THE DIVISION" (E.G., GET RID OF UNEEDED OR SELDOM USED EQUIPMENT, SUBSTITUTE AGILITY AND FIREPOWER FOR MASS). THIS STILL LEAVES A LARGE LOGISTICS CHALLENGE -- (PAUSE FOR NEXT SLIDE)

SLIDE 5 OFF

LOGISTICS IMMUTABLES



1. A TON IS A TON
2. A CUBIC YARD IS A CUBIC YARD
3. A MILE IS A MILE
4. A MINUTE IS A MINUTE
5. SIMPLICITY IS GOODNESS

CERTAIN THINGS ARE IMMUTABLE
NOW – IN 20 YEARS – IN 100 YEARS

SLIDE 6 ON

THE CHALLENGES - LOG IMMUTABLES

- o THE CHALLENGE IS TO FIND A WAYS TO BEAT THE "LOGISTICS IMMUTABLES".
- o A TON IS ALWAYS A TON - BUT UP TO 50 PERCENT OF AMMUNITION WEIGH IS PACKAGING MATERIEL. IF WE CAN REDUCE ITS WEIGHT, WE CAN CARRY MORE (E.G., LOGISTICS R&D - "IMPROVED AMMO PACKAGING" - USING PLASTIC AND FOAM TUBES TO REPLACE HEAVY STEEL "AMMO CANS" USED TO PACK ARTILLERY PROPELLENT CHARGES)
- o A CUBIC YARD - OR METER - CANNOT BE MADE SMALLER - BUT UP TO 30 PERCENT OF AMMUNITION BULK IS PACKAGING MATERIEL, WE CAN SAVE HERE (E.G., PLASTIC, ILO STEEL OR WOOD AMMO BOXES.)
- o A MILE IS A MILE - BUT MORE FUEL EFFICIENT VEHICLES WILL REDUCE POL REQUIREMENTS, AND BETTER POL PIPELINES CAN ELIMINATE "HIGHWAY MILES".
- o A MINUTE IS A MINUTE - BETTER AND MORE MATERIELS HANDLING EQUIPMENT CAN DO THE JOB QUICKER AND WITH FEWER PEOPLE (E.G., THE PALLETIZED LOADING SYSTEM; ROBOTIC MHE-)
  - oo TERMINAL TRANSFER UNIT BY INCREASED FORKLIFTS FROM 15 TO 39 INCREASED CAPACITY FROM 900 ST/DH TO 3000 ST/DH.
  - oo ROBOTIC FORKLIFT BEING DEVELOPED FOR THE BATTLEFIELD ROBOTIC AMMUNITION SUPPLY SYSTEM (BRASS) WILL HAVE A CYCLE TIME OF 20 SECONDS.

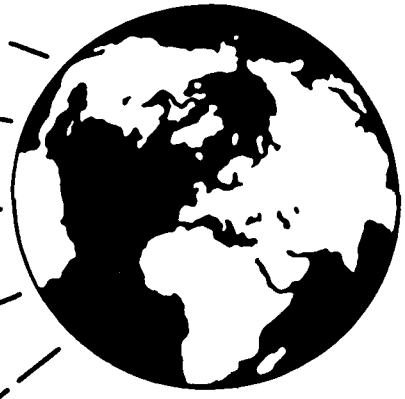
(CONTINUED NEXT PAGE)

- COMPLEX EQUIPMENT TAKES SMART PEOPLE TO OPERATE AND SMARTER ONES TO MAINTAIN - BUT IF WE CAN DEVELOP BETTER BUILT-IN TEST EQUIPMENT, THEY CAN DO IT QUICKER AND BETTER. THE FAULT DETECTION LOCATION SYSTEM (FDLS) IN THE APACHE IS AN EXAMPLE.
- WITH THESE "IMMUTABLES" AND OUR APPROACHES IN MIND, I'D LIKE TO LEAD YOU INTO OUR CONCEPT OF "SUPPORTING THE FUTURE FORCE."

SLIDE 6 OFF

BATTLEFIELD PERSPECTIVE YEAR 2000

- GLOBAL IN SCOPE
- FULL SPECTRUM OF CONFLICT
- MULTIPLE SCENARIOS
- AGILE, FAST MOVING, MOBILE
- INTEGRATED BATTLEFIELD - ARMS & SERVICES
- INTEROPERABILITY
- INCREASED LETHALITY/DISRUPTION/DIMENSION
- CHEMICAL/NUCLEAR/ELECTRONIC
- FIGHT IN DISPERSED CELLS
- RAPID DECISION MAKING
- HI-TECH/SOPHISTICATION/AUTOMATION
- MAJOR RESOURCE REQUIREMENTS
  CONSTRAINED RESOURCES



(SLIDE 7 (DELETED)

(SLIDE 8 ON)

BATTLEFIELD PERSPECTIVE -- (21ST CENTURY/YEAR 2000 AND BEYOND)

- o THIS IS A LOGISTICAN'S PERSPECTVE OF THE BATTLEFIELD OF THE 21ST CENTURY.
  - oo TODAY'S EQUIPMENT, DISTRIBUTION AND SUPPORT SYSTEMS AND PROCEDURES WILL NOT MEET OUR BATTLEFIELD NEEDS.

- o WE WILL LIVE WITH CONSTRAINED RESOURCES. BUT I BELIEVE THE CHALLENGES CAN BE MET: HERE ARE SOME OF THEM.
  - oo GLOBAL IN SCOPE -- NOT JUST ONE OR TWO THEATERS;
  - oo FULL SPECTRUM OF CONFLICT -- FROM TERRORISM TO NUCLEAR WAR;
  - oo MULTIPLE SCENARIOS -- OCCURRING SIMULTANEOUSLY;
  - oo AGILE, FAST MOVING, MOBILE -- DUE TO TECHNOLOGY;
  - oo INTEGRATED BATTLEFIELD -- ALL COMBAT AND SUPPORT FORCES COORDINATED;
  - oo INTEROPERABILITY -- FORCES AND MATERIEL DESIGNED/ORGANIZED TO MEET MULTIPLE REQUIREMENTS.

- o NEW CONCEPTS - SUCH AS ARMY 21-WILL DRAMATICALLY CHANGE THE NATURE OF WARFARE AND PRESENT ENROMOUS CHALLENGES TO THE LOGISTICIAN.

(SLIDE 8 OFF)

MATERIEL IMPLICATIONS YEAR 2000

- MATERIEL THAT IS:
  - TECHNICALLY SUPERIOR • HIGHLY MOBILE • MULTIFUNCTIONAL
  - INTEROPERABLE • SURVIVABLE • AFFORDABLE • SUPPORTABLE
  - TRANSPORTABLE • RELIABLE • MODULAR • DURABLE • EASILY OPERATED AND MAINTENED
- DISTRIBUTION WHICH:
  - IS RAPID AND RELIABLE • INSURES ISSUE OF ALL OF A SYSTEM'S COMPONENTS
  - MINIMIZES TURBULENCE DURING EQUIPMENT TRANSITION • EMPHASIZES PREDICTIVE DISTRIBUTION PLANNING • ASSET VISIBILITY TO THE LOWEST LEVEL
- SUPPORT WHICH IS:
  - COMPLETE • CONTINUOUS • HIGHLY PRODUCTIVE
  - EFFECTIVE • RELIABLE • TAILORABLE • INTEROPERABLE • MAXIMIZES INDUSTRIAL BASE, WHOLESALE SYSTEM AND INSTALLATION SUPPORT
  - NEAR REAL TIME • FULLY INTEGRATED • LESS RESOURCE INTENSIVE
- MATERIEL MANAGEMENT WHICH:
  - INTEGRATES MATERIEL, DISTRIBUTION AND SUPPORT FUNCTIONS • SUPPORTS THE TOTAL ARMY • PREDICTS AND AVOIDS MATERIEL FAILURES
  - STANDARDIZES AND CONTROLS PLANNING FACTORS AND DATA BASES
  - STABILIZES REQUIREMENTS AND PRIORITIES • CONTINUOUSLY BALANCES COST AGAINST BATTLEFIELD CAPABILITY

MATERIEL IMPLICATIONS - YEAR 2000

(SLIDE 9 ON)

- o GIVEN THE BATTLEFIELD PERSPECTIVE, HERE'S A LOOK AT WHAT IS REQUIRED TO EQUIP AND SUSTAIN THE TOTAL ARMY. IT'S NOT ALL INCLUSIVE, NOR WILL I DISCUSS EACH ITEM.
- o THE "MATERIEL" CATEGORY ENCOMPASSES DEVELOPMENT AND ACQUISITION. (PAUSE)
- o SHOULD EMPHASIZE THAT SUPPORT MUST REPRESENT A CONTINUOUS FLOW WHICH CAPITALIZES ON SUPPORT CAPABILITIES OF THE INDUSTRIAL BASE AND OUR WHOLESALE AND RETAIL LOGISTICS SUPPORT SYSTEM -- INCLUDING INSTALLATIONS -- IT MUST BE RESOURCED EFFICIENTLY -- AND MUST BE CAPABLE OF TRANSITIONING SMOOTHLY FROM PEACE TO WAR AND SURGING TO MEET MOBILIZATION NEEDS. (PAUSE)
- o ONCE WE'VE ACCOMMODATED THE FIRST THREE, WE MUST TIE THEM TOGETHER WITH EFFECTIVE, COHESIVE MATERIEL MANAGEMENT.
- o THE IMPLICATIONS SHOWN LED TO THE DEVELOPMENT OF FOUR SPECIFIC OBJECTIVES WHICH I'LL COVER IN DETAIL.

(SLIDE 9 OFF)

TOTAL ARMY GOALS

The mission of the Total Army is to deter any attack upon U.S. national interests and, if deterrence fails, to engage and defeat any enemy in any environment.

READINESS
A Total Army prepared for the "three days of war": to deter the day before war; to fight and win on the day of war; and to terminate conflict in such a manner that on the day after war, the United States and its allies have an acceptable level of security.

HUMAN
A Total Army composed of military and civilian professionals who loyally serve their nation in rewarding careers.

LEADERSHIP
A Total Army whose leaders [illegible]

MATERIEL
A Total Army equipped and sustained to win any land battle.

FUTURE DEVELOPMENT
A Total Army sensitive to innovative approaches to accomplish its mission.

STRATEGIC DEPLOYMENT
A Total Army organized, manned, and equipped so as to be capable of deploying, with transportation assistance, to any part of the globe to counter a wide spectrum of threats.

MANAGEMENT
A Total Army which efficiently and effectively uses the resources made available.

John O. Marsh Jr.

John O. Marsh Jr.
Secretary of the Army

MATERIEL GOAL

- **MATERIEL OBJECTIVE**

  MATERIEL WHICH MEETS THE NEEDS OF THE ARMY THROUGH THE YEAR 2000

- **DISTRIBUTION OBJECTIVE**

  MATERIEL DISTRIBUTED TO THE RIGHT PLACE ON TIME, IN THE QUANTITY REQUIRED

- **SUPPORT OBJECTIVE**

  RESPONSIVE LOGISTICS SUPPORT SYSTEMS

- **MATERIEL MANAGEMENT OBJECTIVE**

  INNOVATIVE MANAGEMENT OF RESOURCES

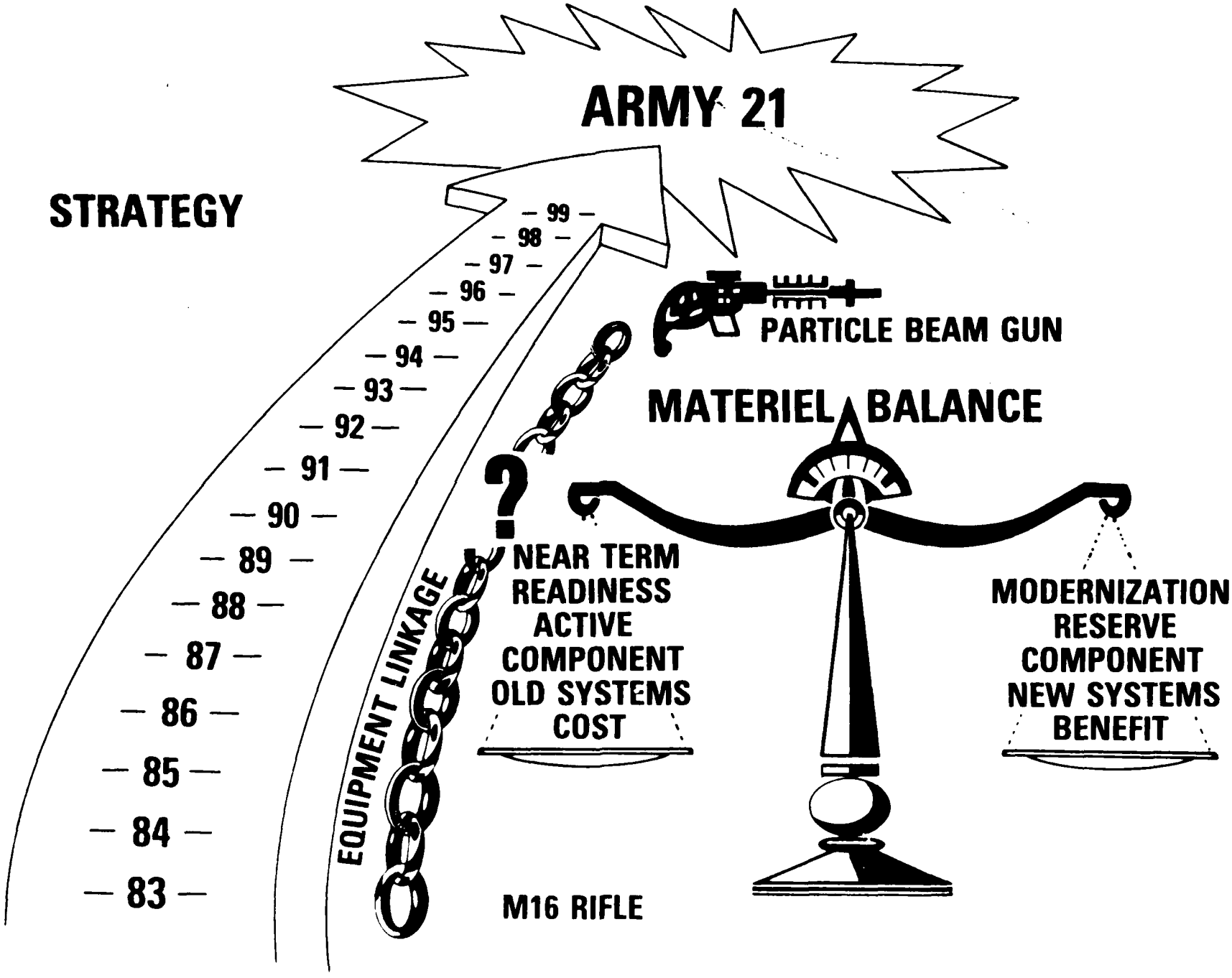
(SLIDE 11 ON)

MATERIEL GOAL

THE MATERIEL GOAL IS FURTHER EXPANDED INTO FOUR SUPPORTING OBJECTIVES WHICH PROVIDE FUTURE DIRECTION AND CONTINUITY TO OUR EFFORTS.

- THESE FOUR OBJECTIVES - "MATERIEL," "DISTRIBUTION," "SUPPORT," AND "MATERIEL MANAGEMENT" - PROVIDE THE LINK FROM THE BROAD "MATERIEL" GOAL TO OUR FUTURE STRATEGY, AND WILL FORM THE FRAMEWORK FOR THE CONTINUATION OF MY REMARKS.

(SLIDE 11 OFF)


ARMY 21
STRATEGY
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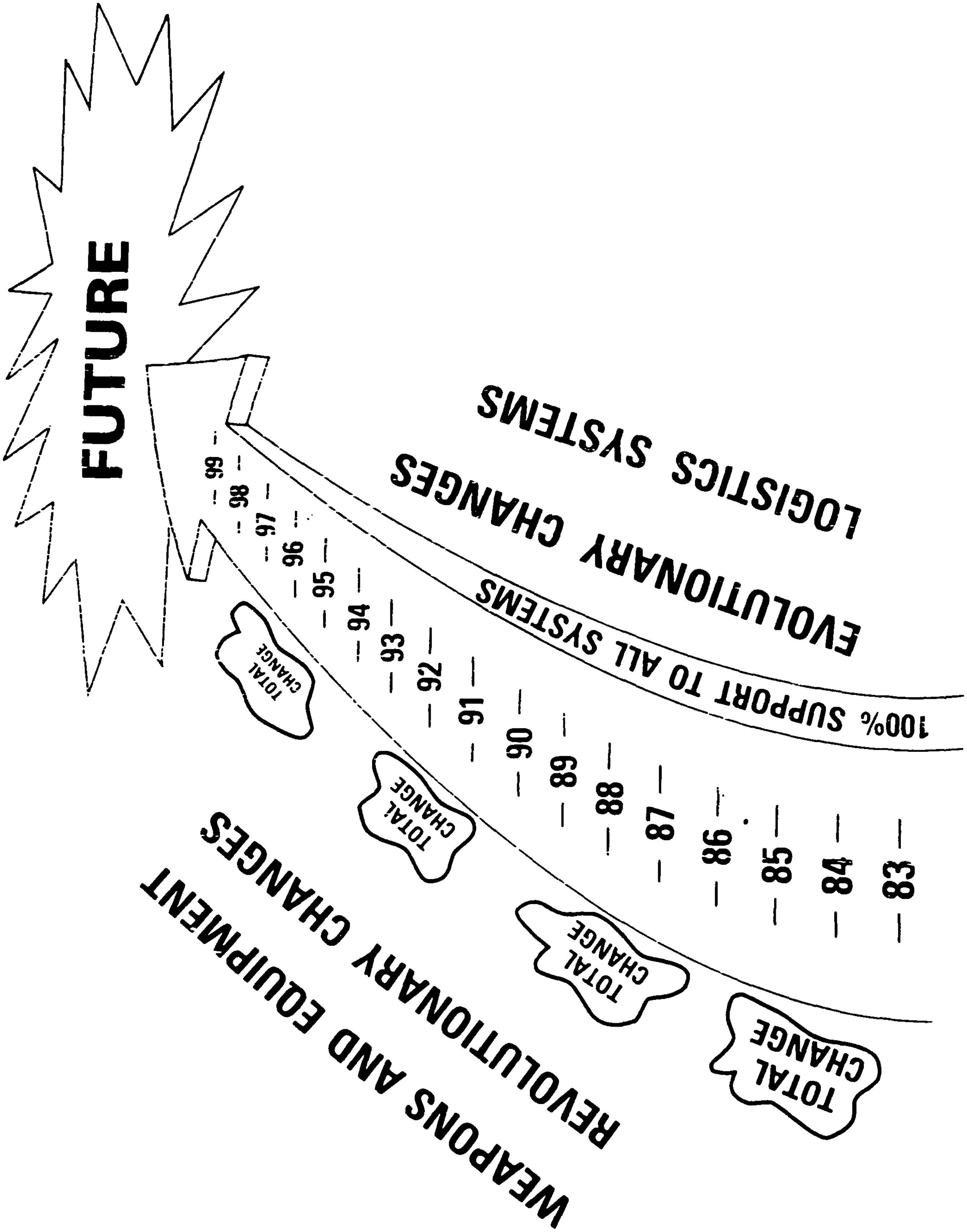
83
PARTICLE BEAM GUN
MATERIEL BALANCE
?
EQUIPMENT LINKAGE
NEAR TERM
READINESS
ACTIVE
COMPONENT
OLD SYSTEMS
COST
MODERNIZATION
RESERVE
COMPONENT
NEW SYSTEMS
BENEFIT
M16 RIFLE

(SLIDE 12 ON)

STRATEGY FOR ARMY 21

- o A TRULY COMPREHENSIVE STRATEGY IS NEEDED.
- o IT'S NOT A "STRAIGHT SHOT" BETWEEN NOW AND YEAR 2000--AS WE ARE MOVING FORWARD MUST INSURE THAT BALANCE IS ACHIEVED THROUGHOUT THE TRANSITION. BALANCE SO-
  - oo THAT MATERIEL IS READY WHEN NEEDED--READINESS IS ENHANCED AS WE MODERNIZE;
  - oo THAT TOTAL ARMY REQUIREMENTS ARE CONSIDERED--BOTH ACTIVE AND RESERVE COMPONENTS;
  - oo THAT OLD AND NEW SYSTEMS WORK TOGETHER;
  - oo THAT WE CONSTANTLY WEIGH COST VERSUS BENEFIT TO BE GAINED;
- o WE CAN ALSO LOOK AT IT AS A CHAIN WHICH TAKES US FROM ONE MATERIEL SYSTEM TO ANOTHER AS WE PROGRESS FROM THE SUPPORT REQUIRED TODAY TO THAT OF TOMORROW--MUST HAVE LINKA(TO INSURE SMOOTH TRANSITION AND IMPROVED EFFECTIVENESS.

(SLIDE 12 OFF)


FUTURE
LOGISTICS SYSTEMS
EVOLUTIONARY CHANGES
100% SUPPORT TO ALL SYSTEMS
WEAPONS AND EQUIPMENT
REVOLUTIONARY CHANGES
TOTAL CHANGE
TOTAL CHANGE
TOTAL CHANGE
TOTAL CHANGE
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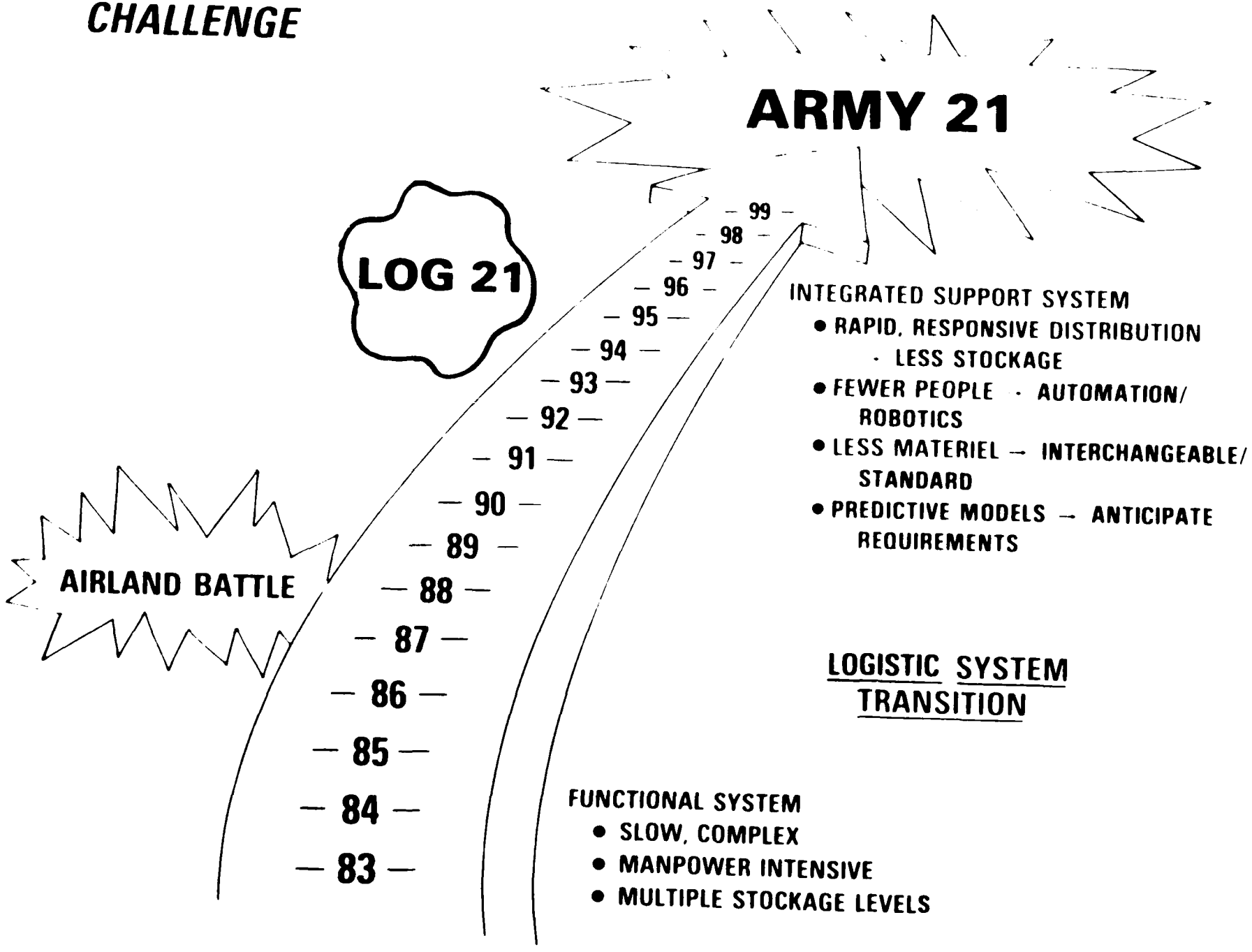
SLIDE 13 ON

LOGISTICS EVOLUTION

- THERE IS ANOTHER IMPORTANT THING THAT WE MUST REMEMBER ABOUT LOGISTICS IMPROVEMENTS--
  - THEY ARE "EVOLUTIONARY;" NOT "REVOLUTIONARY."
- WHEN AN M-60 TANK BATTALION RECEIVES M-1S, THE CHANGE IS "REVOLUTIONARY" TO THAT UNIT - NEVER AGAIN DOES IT NEED TO CONCERN ITSELF WITH THE LIMITATIONS AND TACTICS OF THE M-60.
  - WHEN THE "FREED-UP" M-60S REPLACE THE M-48S IN ANOTHER UNIT, THAT UNIT IS LIKE WISE "REVOLUTIONIZED," AND SO ON.
- BUT THE LOGISTICAL SYSTEM CAN CHANGE ONLY EVOLUTIONARILY, FOR AS LONG AS THE ITEM IS IN OUR, OR AN ALLY'S, INVENTORY, WE MUST <u>DISTRIBUTE IT</u>, <u>SUPPORT</u> IT, AND, IF ITS IS <u>OUR</u> INVENTORY, <u>MANAGE</u> IT.

SLIDE 13 OFF

CHALLENGE


ARMY 21
LOG 21
AIRLAND BATTLE
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INTEGRATED SUPPORT SYSTEM
• RAPID, RESPONSIVE DISTRIBUTION - LESS STOCKAGE
• FEWER PEOPLE - AUTOMATION/ ROBOTICS
• LESS MATERIEL - INTERCHANGEABLE/ STANDARD
• PREDICTIVE MODELS - ANTICIPATE REQUIREMENTS
LOGISTIC SYSTEM TRANSITION
FUNCTIONAL SYSTEM
• SLOW, COMPLEX
• MANPOWER INTENSIVE
• MULTIPLE STOCKAGE LEVELS

SLIDE 14 ON

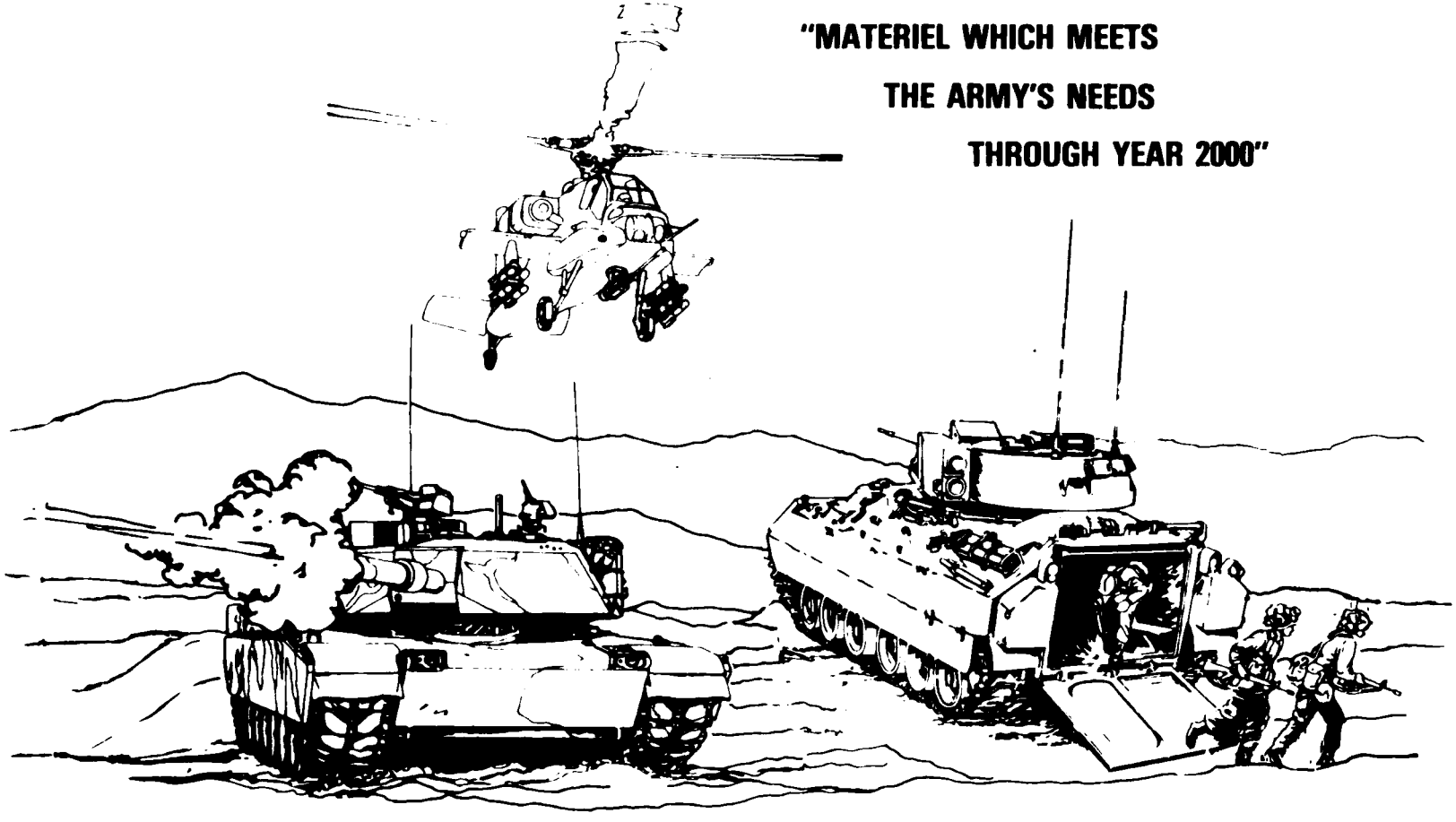
HERE IS THE CHALLENGE. LOOKED AT AS WE TRANSITION.

- o THE LOGISTICS COMMUNITY IS WORKING HARD TO DEVELOP NEW INTEGRATED SUPPORT CONCEPTS AND SYSTEMS TO ESTABLISH AN EVOLUTIONARY TRANSITION PLAN FROM THE PRESENT TO THE FUTURE.
- o THIS PLAN, THE ARMY LOGISTICS LONG RANGE PLAN, (KNOWN AS "LOG 21,") SHOULD BE PUBLISHED IN JUNE 1984.
- o THE TRANSITION MUST
  - oo BE ORDERLY,
  - oo PERMIT THE BEST POSSIBLE SUPPORT AT EVERY STAGE; AND
  - oo ACHIEVE THE SEVERAL BALANCES ALONG THE EVOLUTIONARY RAMP I'VE DESCRIBED.
- o WE WILL LOOK INTO THE FUTURE USING THE FOUR MATERIEL OBJECTIVES, FIRST "MATERIEL," FOLLOWED BY "DISTRIBUTION," "SUPPORT" AND "MATERIEL MANAGEMENT," IN THAT ORDER.

SLIDE 14 OFF

MATERIEL OBJECTIVE –

"MATERIEL WHICH MEETS
THE ARMY'S NEEDS
THROUGH YEAR 2000"



(SLIDE 15 ON)

HERE IS THE MATERIEL OBJECTIVE.

THE MATERIEL OBJECTIVE IS FOR THE ARMY TO HAVE EQUIPMENT WHICH MEETS ITS NEEDS INTO THE YEAR 2000 AND BEYOND.

THE ARMY IS MODERNIZING ITS EQUIPMENT.

- o OVER 400 NEW "SYSTEMS" WILL ENTER THE INVENTORY IN THIS DECADE. (*LEFT BOX*)
  - oo TRANSLATES TO 389,000 "EACH'S) (RIGHT BOX)
- o YET IT'S SAFE TO ASSUME THAT MOST OF THE MAJOR SYSTEMS, INCLUDING SOME OF THOSE DISPLACED, WILL BE WITH US IN THE YEAR 2000 AND BEYOND.
  - oo THE M1 TANK, BRADLEY FIGHTING VEHICLE, APACHE AND BLACK HAWK ARE EXAMPLES.
  - oo WITH THEM WILL BE OLDER WEAPONS, LIKE THE M60A3 TANK AND THE M109 HOWITZER.

THERE WILL UNDOUBTEDLY BE PRODUCT IMPROVEMENTS OVER THE YEARS - IN FACT, WE CONSCIOUSLY PLAN FOR THIS; OUR COBRA FLEX PROGRAM, BEING ONE EXAMPLE.

- o MAJOR REASON FOR PRODUCT IMPROVEMENTS IS TO IMPROVE EQUIPMENT "SUPPORTABILITY."

(SLIDE 15 OFF)

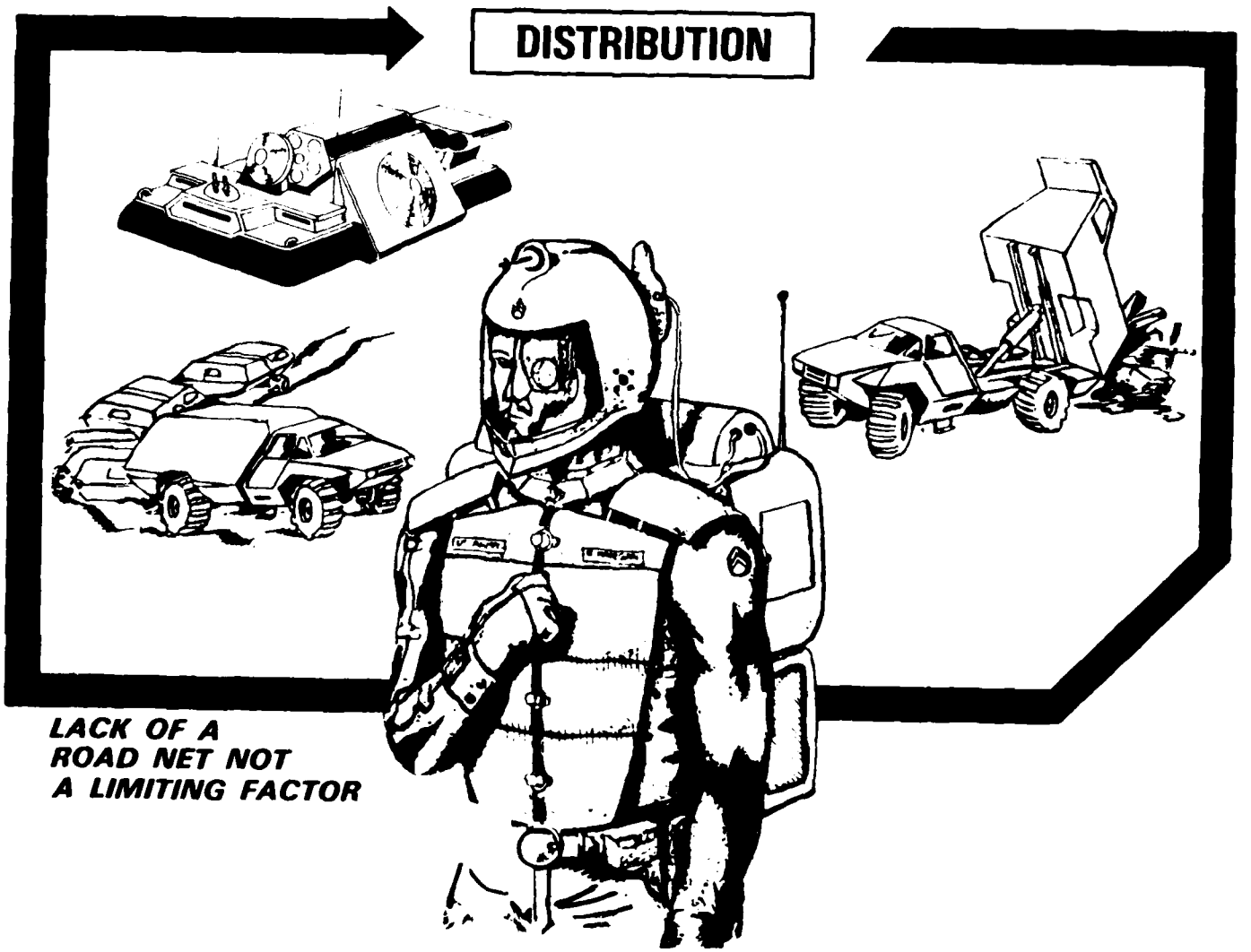
o EXAMPLES OF NEW ITEMS TO BE INTRODUCED IN FY 84/85	
oo "MAN" 10 TON TRUCK	oo HEMTT
oo PERSHING II	oo MOBILE PROTECTED GUN
oo SQUAD AUTOMATIC WEAPON	oo PATRIOT
oo STE (STANDARD TEST EQUIPMENT FOR M-1 & M-2	oo FAST ATTACK VEHICLE
oo HMMWV	oo SINCGARS (SINGLE CHANNEL GROUND AIRBORNE RADIO SYSTEM)

COMMAND	
o TACOM	86,654
o CECOM	54,991
o AMCCOM	84,349
o MICOM	139,099
o TROSCOM	23,091
o AVSCOM	1,667
	~~389,851~~

1/ I DID NOT INCLUDE AMMOCM'S NON-MRIS ITEMS...7.7M BULLETS

DISTRIBUTION OBJECTIVE –

"MATERIEL DISTRIBUTED TO RIGHT PLACE, AT RIGHT TIME, IN RIGHT QUANTITY"



LACK OF A ROAD NET NOT A LIMITING FACTOR

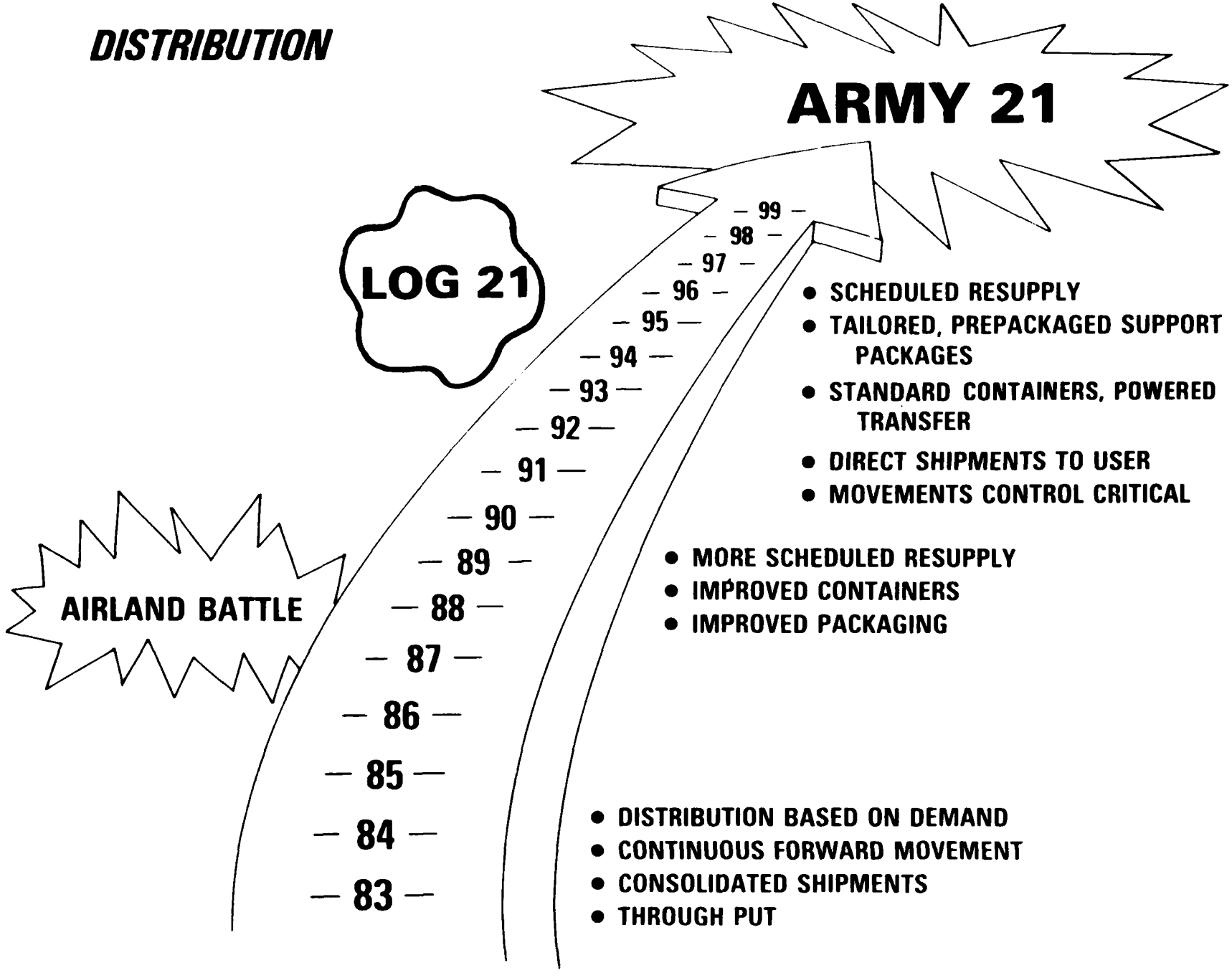
(SLIDE 18 ON)

THE DISTRIBUTION CHALLENGE.

- o AT THE RISK OF BEING REDUNDANT, THE DISTRIBUTION SYSTEM OF THE FUTURE MUST BE BASED ON RESPONSIVE RESUPPLY, AUTOMATIC INVENTORY STATUS REPORTING, AND PREDICTIVE DEMAND AND USAGE RATES.
- o WE NEED VEHICLES, SUCH AS THE PALLETIZED LOADING SYSTEM (PLS), WHICH CAN BE VIEWED AS A DISTRIBUTION SYSTEM, NOT JUST A TRANSPORTATION TRUCK.
- o TAILORED, PALLETIZED, CONTAINERIZED UNIT SUPPORT PACKAGES WILL BE THE NORM.
  - oo SUPPLIES WILL BE DELIVERED TO UNITS IN ONE-, TWO-, OR FIVE-DAY PACKAGES.
  - oo MANY SHIPMENTS WILL COME DIRECTLY FROM THE SUSTAINING BASE TO THE UNIT.
- o THE NET RESULT WILL BE MOVEMENT OF SMALLER QUANTITIES, MORE OFTEN, TO MULTIPLE, DISPERSED SITES.
- o WE MUST HAVE COMPUTERS, COMMUNICATIONS, AND TRANSPORTATION THAT WILL ENABLE US TO:
  - oo FORECAST UNIT REQUIREMENTS.
  - oo FIND OUT WHERE THEY ARE LOCATED.
  - oo RESPONSIVELY MEET THEIR DAILY NEEDS.
  - oo BE ABLE TO PRIORITIZE AND CONTROL TRANSPORTATION.

(CONTINUED NEXT PAGE)

DISTRIBUTION



(SLIDE 17 ON)

OUR DISTRIBUTION OBJECTIVE IS TO ENSURE THAT THE RIGHT MATERIEL IS DISTRIBUTED TO THE RIGHT PLACE, ON TIME, AND IN THE QUANTITY REQUIRED.

- o CURRENT SYSTEM IS REACTIVE, BASED ON DEMAND, AND INVOLVES AN ALMOST CONTINUOUS FORWARD MOVEMENT OF SUPPLIES.
- o STRATEGY:
  - oo OUR STRATEGY CALLS FOR DEVELOPING SIMPLIFIED, RAPID DISTRIBUTION TECHNIQUES THROUGH ENHANCED USE OF AUTOMATION, COMMUNICATIONS, AND RAPID TRANSPORT.
  - oo WE CAN REDUCE BOTH THE DEPTH AND BREADTH OF STOCKAGE AND CUMBERSOME FIELD REQUISITIONING THROUGH PREDICTIVE PLANNING AND "INVENTORY IN MOTION" TECHNIQUES--EMPHASIS ON AGGRESSIVE SUPPORT FROM THE WHOLESALE LEVEL RATHER THAN WAITING FOR, OR REQUIRING, THE FIELD COMMANDER TO INITIATE THE ACTION.
  - oo THROUGH REDUCED OR COMMON DATA BASES AND MANAGEMENT LEVELS WE CAN PROMOTE RESPONSIVE DISTRIBUTION WHILE IMPROVING ACCOUNTABILITY, AGAIN, EXPLOITATION OF TECHNOLOGY, MUCH OF WHICH IS EXISTANT, IS THE KEY.

(SLIDE 17 OFF)

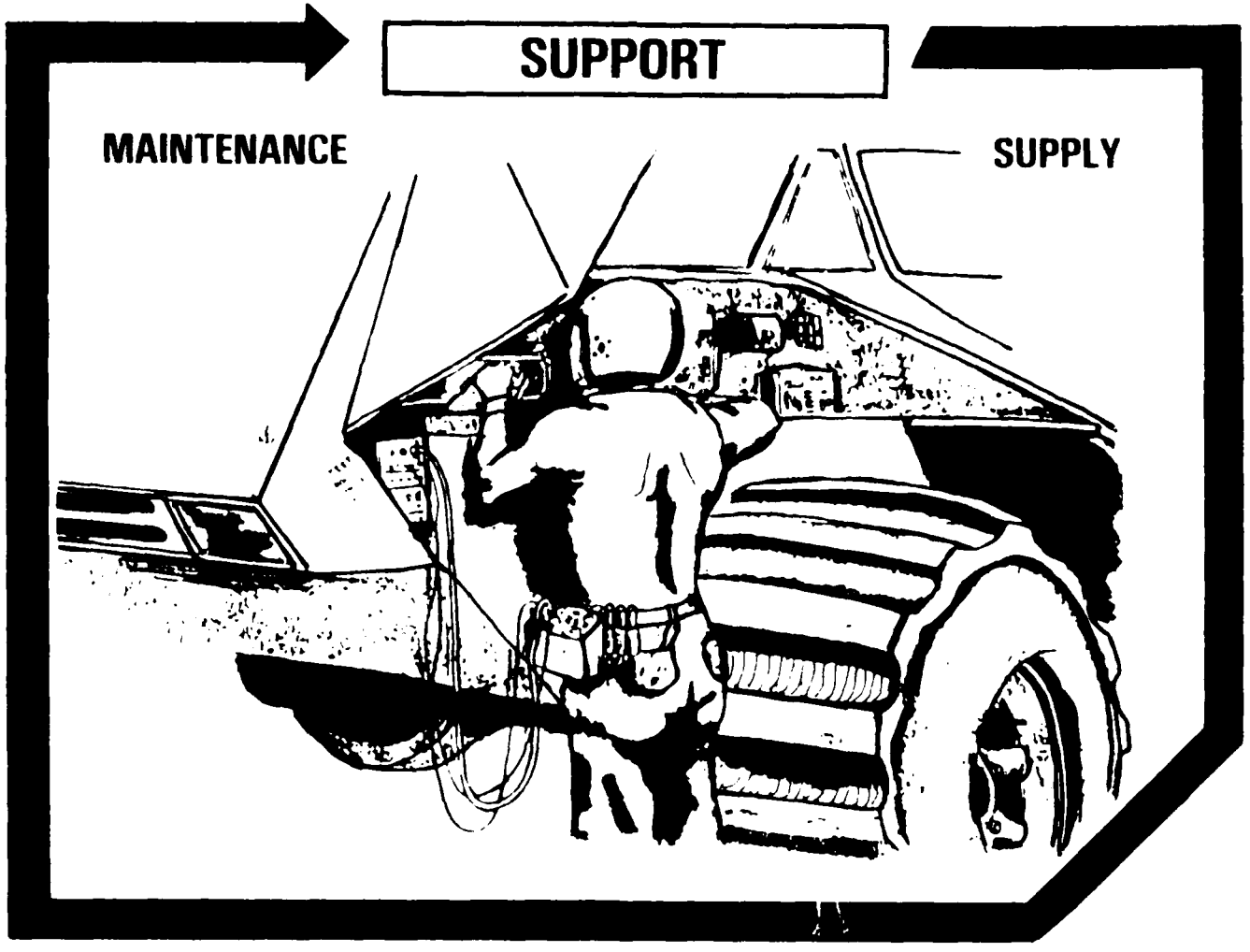
- o WE MUST IMPROVE OUR BULK FUEL DISTRIBUTION CAPACITY.
  - oo WE ARE DEVELOPING LIGHTWEIGHT ALUMINUM PIPE AND SNAP-LOCK COUPLINGS TO REPLACE THE HEAVY STEEL PIPE AND COUPLINGS NOW IN USE.
  - oo LOGISTICS R&D IS WORKING ON AN AUTOMATED PIPELINE CONSTRUCTION EQUIPMENT SYSTEM (APCES) WHICH WILL PERMIT 2 MEN TO LAY 18 MILES OF PIPE - CURRENT RATE FOR A PIPELINE COMPANY IS 1 MI/DA.

(SLIDE 18 OFF)

SUPPORT OBJECTIVE –

"RESPONSIVE LOGISTICS SUPPORT SYSTEMS"

ARMY 21



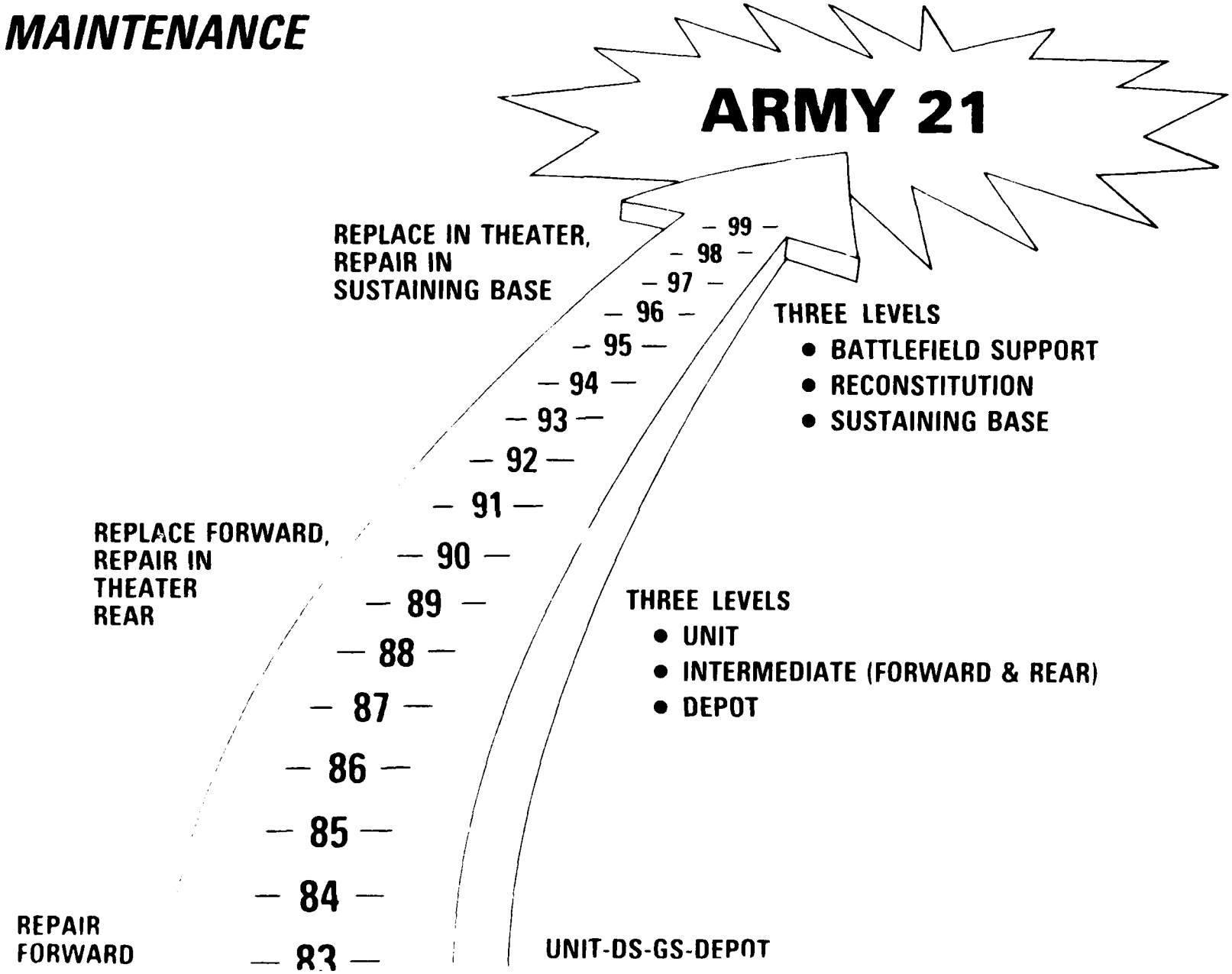
(SLIDE 19 ON)

SUPPORT OBJECTIVE

THE THIRD MATERIEL OBJECTIVE, "SUPPORT," CALLS FOR A RESPONSIVE LOGISTICS SUPPORT SYSTEM THAT CAN BE SUSTAINED. "SUPPORT" IS A COMBINATION OF SEVERAL FUNCTIONS, TO INCLUDE "MAINTENANCE" AND "SUPPLY".

(SLIDE 19 OFF)

MAINTENANCE



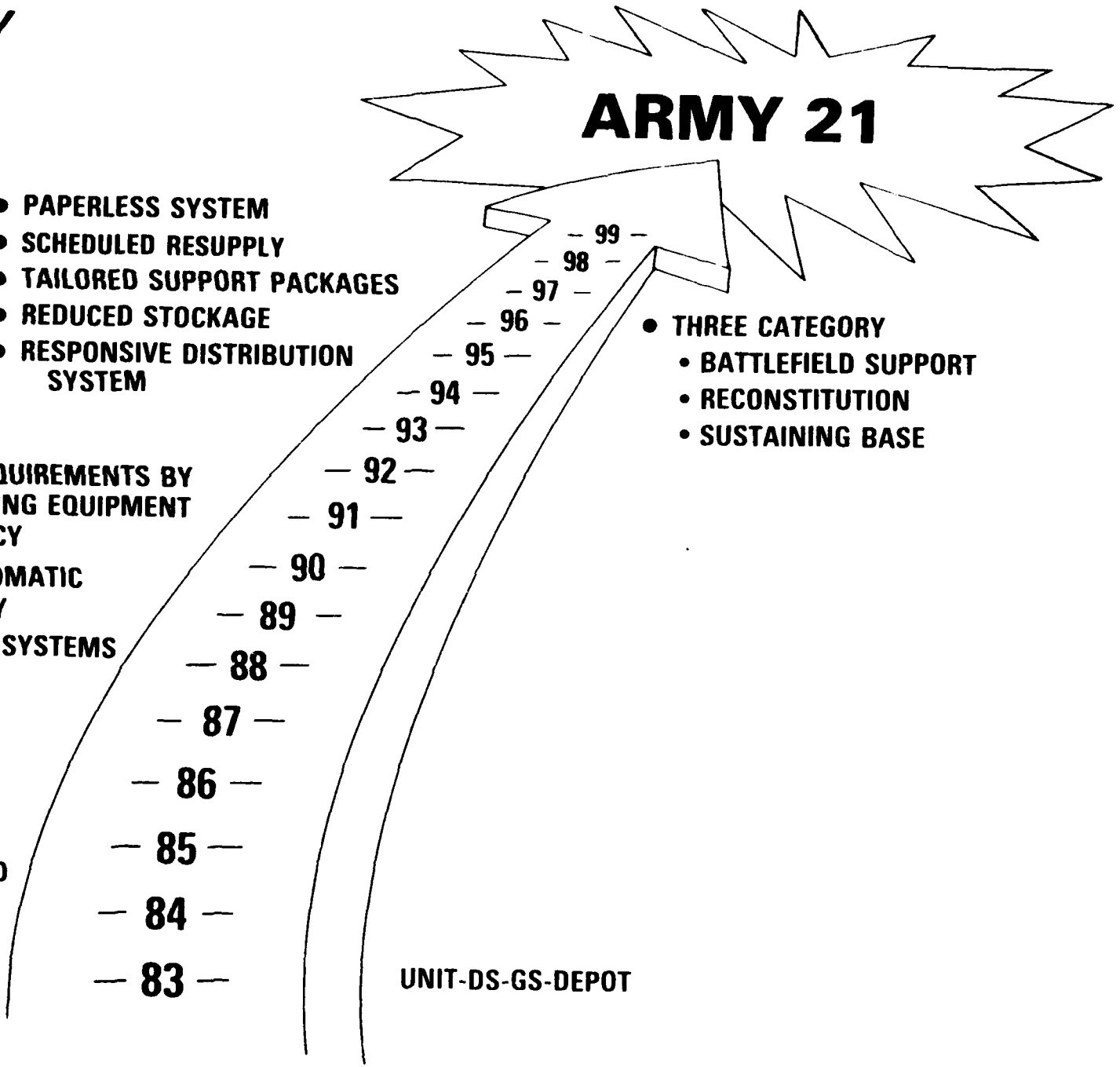
(SLIDE 20 ON)

MAINTENANCE

- o 3 LEVEL SYSTEM DEVELOPED: UNIT, INTERMEDIATE, DEPOT; LOGC FINALIZING NOW: ALL COMMODITIES/TOTAL ARMY.
  - oo THRUST: REPAIR BY REPLACEMENT IN CORPS (GRN SUITERS): DETAILED REPAIR OUT OF CORPS (CONTRACT MAINT).
  - oo 3 MAINT PRIORITIES FOR HI-TECH DESIGN: DISCARD, REPLACE FWD, EVAC (IN THAT ORDER).
- o PCB (PRINTED CIRCUIT BOARDS) POLICY: IN REVISED AR 750-1 (MAR 83); UNIQUE IN DOD.
  - oo FIRST COMPREHENSIVE POLICY TO GUIDE INCORPORATION OF NEW ELECTRONIC TECHNOLOGY
  - oo SETS GOALS: MAX BIT/BITE (BUILT-IN-TEST/EQUIP): FAULT ISOLATE TO "BLACK BOX"
- o TMDE: CENTRAL MGMT STRUCTURE ESTABLISHED -
  - oo MODERNIZATION PROG: EXPLOITS TECH, MORE OFF-THE-SHELF/NON-DEV ITEMS
  - oo MORE AUTOMATIC TEST EQUIP (ATE) W/EMPHASIS ON GEN PURP AND STANDARD SOFTWARE LANGUAGE (ATLAS-AUTO TEST LANG FOR ALL SYS)
- o ALREADY MENTIONED - "FAULT DETECTION LOCATION SYSTEM" (FDLS) IN THE APACHE WHICH PROVIDES A "GO/NOGO" TEST AVILITY.

(SLIDE 20 OFF)

SUPPLY


ARMY 21
• PAPERLESS SYSTEM
• SCHEDULED RESUPPLY
• TAILORED SUPPORT PACKAGES
• REDUCED STOCKAGE
• RESPONSIVE DISTRIBUTION SYSTEM
• THREE CATEGORY
• BATTLEFIELD SUPPORT
• RECONSTITUTION
• SUSTAINING BASE
• REDUCE REQUIREMENTS BY INCREASING EQUIPMENT EFFICIENCY
• MORE AUTOMATIC RESUPPLY
• PAPERLESS SYSTEMS
• PAPER, DEMAND SYSTEM
• LAYERS OF STOCKAGE
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UNIT-DS-GS-DEPOT

(SLIDE 21 ON)

SUPPLY CHALLENGES.

NOW FOR THE SUPPLY FUNCTION:

OUR SUPPLY SYSTEM IS TOO COMPLEX, TIME CONSUMING, HIGHLY PAPER-BOUND, MANPOWER INTENSIVE, AND HAS TOO MANY LAYERS OF STOCKAGE.

- o LOGISTICANS REFER TO THESE REDUNDANT STOCKAGE LEVELS AS "THE IRON MOUNTIAN."
- o THESE "MOUNTAINS OF IRON" ARE MAJOR CONTRIBUTORS TO THE LONG SUPPORT TAIL, AND, RESULT IN MAINTENANCE AND SUPPLY UNITS HAVING SO MUCH STOCK ON HAND, THEY CANNOT MOVE IT TO KEEP UP WITH THE UNITS THEY SUPPORT.
- o LIKE MAINTENANCE, THE MAJOR CHALLENGE IS TO REDUCE THE ECHELONS OF SUPPLY AND THE INVENTORIES WITHIN THOSE ECHELONS.
- o CONCURRENTLY, WE MUST MAKE MAXIMUM USE OF NEW TECHNOLOGY WHICH WILL GIVE US:
  - oo PAPERLESS TRANSACTIONS:
  - oo RAPID COMMUNICATIONS TO TRANSMIT UNUSUAL REQUESTS:
  - oo TAILORED UNIT SUPPORT PACKAGES:
  - oo SCHEDULED RESUPPLY
  - oo LOW WEIGHT, LOW-BULK ITEMS: AND
  - oo A FASTER, MORE RESPONSIVE DISTRIBUTION SYSTEM TO ALLOW REDUCED INVENTORIES AND STOCKAGE.

(SLIDE 21 OFF)

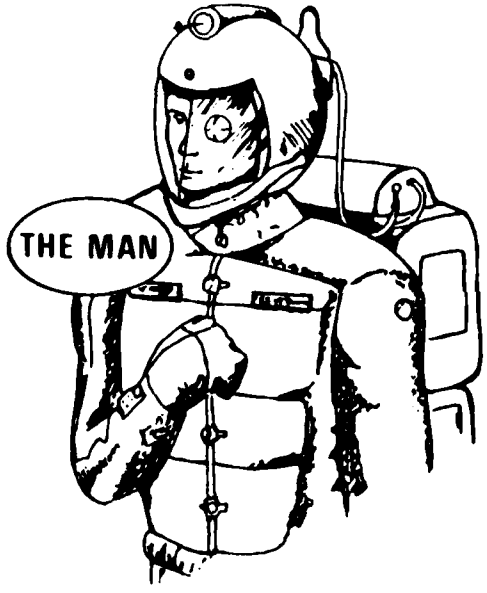
ARMY 21
SERVICES

BATH

LAUNDRY

CLOTHING
EXCHANGE

LABOR



GR

DECONTAMINATION

PERSONAL
SERVICES

BAKERY

FOOD SERVICE

(SLIDE 22 ON)

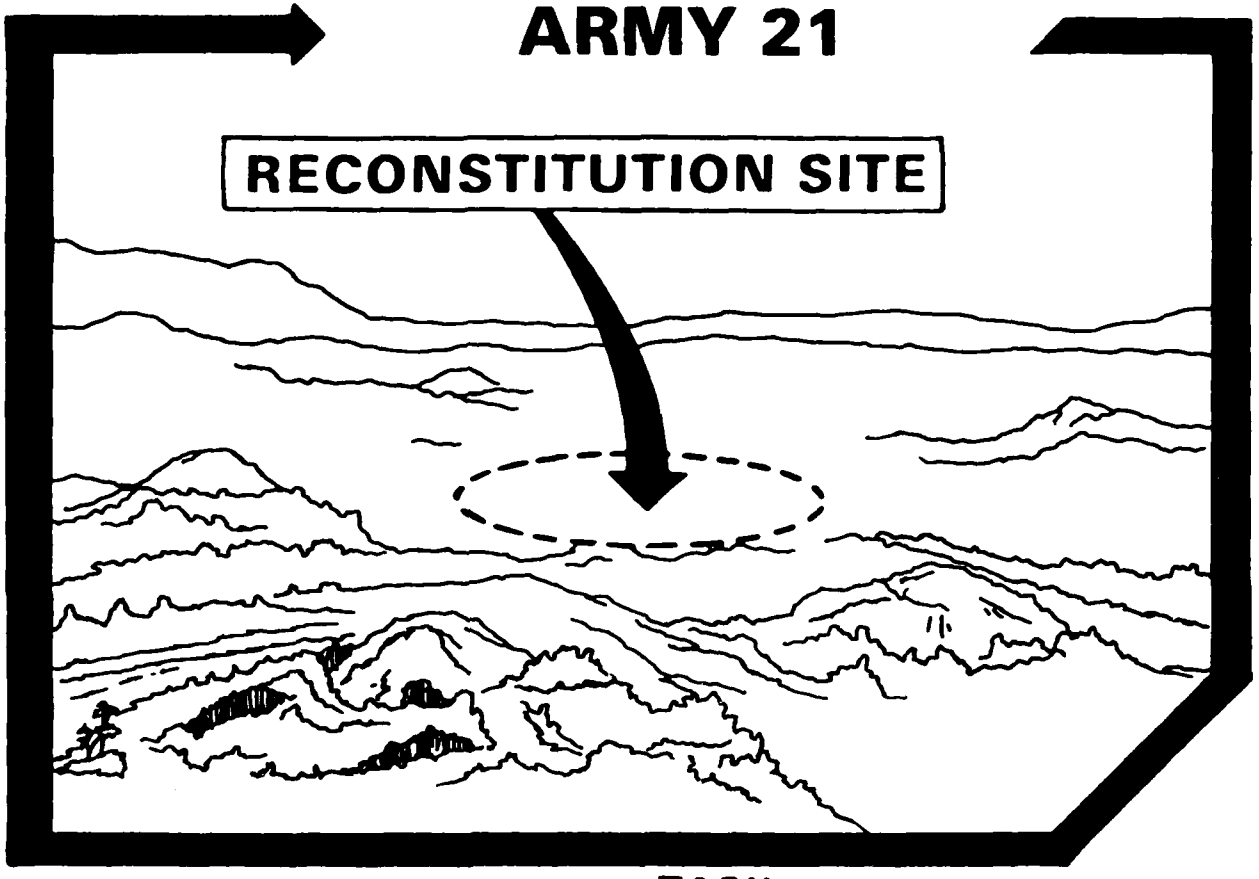
SERVICES.

THE TRULY UNGLAMOROUS SIDE OF OUR BUSINESS, YET -

- o A MAJOR REQUIREMENT FOR THE MAN ON THE BATTLEFIELD ARE SERVICES, SOME OF WHICH ARE SHOWN ON THIS SLIDE.
- o THESE ARE ALSO A MAJOR HEADACHE AND WE NEED TO DO SOMETHING ABOUT THEM.
- o FOR EXAMPLE:
  - oo WE HAVE SOLVED THE WATER PROBLEM WITH ROWPU (REVERSE OSMOSIS WATER PURIFICATION UNITS). BEYOND THIS WE ARE LOOKING AT OTHER PROMISING TECHNOLOGIES.
  - oo THE FOOD SERVICE AND BAKER REQUIREMENT HAVE BEEN LESSENED WITH THE MEAL READY TO EAT AND TRAY PACK RATION.
- o WE STILL NEED TO FIND A WAY TO IMPROVE BATH, LAUNDRY, AND CLOTHING EXCHANGE SERVICES, WHICH WILL LESSEN - NO INCREASE - WATER AND SUPPLY REQUIREMENTS.
- o A MAJOR UNSOLVED PROBLEM IS DECONTAMINATION AFTER CBR ATTACK.
- o GRAVES REGISTRATION (GR) IS A HIGHLY SENSITIVE SERVICE THAT WE MUST LEARN TO COPE WITH ON THE BATTLEFIELD OF THE FUTURE. THE DEFICIENCIES OF PRESENT U. S. MORTUARY EQUIPMENT AND PROCESSES BECAME ALL TOO EVIDENT IN THE AFTERMATH OF THE TERRORIST BOMBING OF THE MARINE HEADQUARTERS IN BEIRUT.

(SLIDE 22 OFF)

ARMY 21



TASK

1 BE PREPARED - SECURE SITE
2 PROVIDE 72 HRS WORTH OF ASSETS
3 PROVIDE NECESSARY MAINTENANCE
4 EXTRACT RESIDUAL SUPPLIES
5 EXTRACT CASUALTIES

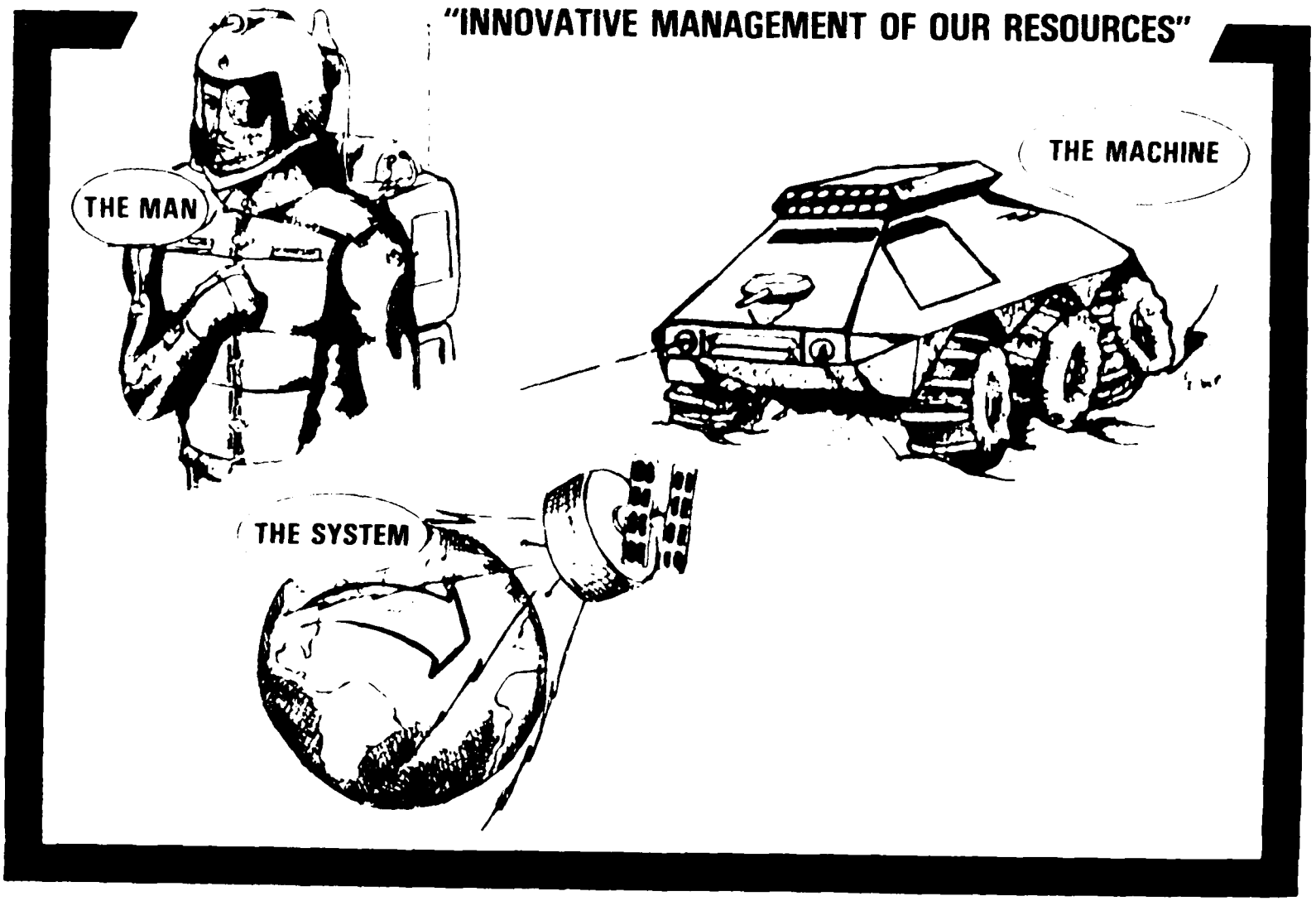
(SLIDE 23 ON)

RECONSTITUTION SITE. LET ME TALK ABOUT A SINGLE EXAMPLE.

- o BECAUSE OF THE EXTREME REQUIREMENTS GENERATED BY COMBAT UNDER ARMY 21 (AIR LAND BATTLE 2000), WE HAVE DEVELOPED A CONCEPT FOR RESTORING COMBAT UNITS, CALLED "RECONSTITUTION" - THIS IS NOT NEW, ITS A RETURN TO A CONCEPT OF THE PAST.
- o THE PURPOSE OF RECONSTITUTION IS TO RETURN THE COMBAT UNIT TO A MISSION CAPABLE STATUS, IN THE SHORTEST TIME AND POSSIBLE.
  - oo WHEN THE COMBAT UNIT COMPLETES A MISSION, IT WILL RENDEZVOUS WITH DESIGNATED THEATER COMBAT SERVICE SUPPORT UNITS.
  - oo THE SUPPORT UNITS WILL BRING WITH THEM A "TAILORED" BATTLEFIELD SUPPORT PACKAGE.
  - oo THE PACKAGE WILL CONSIST OF EQUIPMENT AND SUPPLIES REPORTED THRU DATA LINK, AS BATTLE DAMAGED OR CONSUMED, PLUS THOSE NEEDED FOR THE NEXT MISSION.
  - oo ALL REQUISITIONS WILL BE "PAPERLESS"; MOST WILL BE AUTOMATIC.
  - oo KEY TO MAINTENANCE UNDER THE RECONSTITUTION CONCEPT IS"BATTLEFIELD REPLACEMENT" OF COMPONENTS AND SPARES,TO MAKE THE END ITEM SERVICABLE. NOT "BATTLEFIELD REPAIR:"
- o DESCRIBING THE "RECQNSTITUTION" CONCEPT IS MUCH EASIER THAN IMPLEMENTING IT.
  - oo THE ENTIRE CONCEPT PRESUPPOSES RELIABLE, REAL TIME, SURVIVABLE, MINIATURIZED BATTLEFIELD COMBAT SERVICE SUPPORT AUTOMATION INTEGRATED WITH OTHER PRIMARY SYSTEMS (C&C, FIRE SUPPORT, AIR DEFENSE, AND INTELLIGENCE),
  - oo EQUALLY RELIABLE AND SURVIVABLE LOGISTICS COMMUNICATIONS AND DATA LINKS.

(SLIDE 23 OFF)

MATERIEL MANAGEMENT OBJECTIVE –



(SLIDE 24 ON)

MATERIEL MANAGEMENT OBJECTIVE.

THE "CAPSTONE" OBJECTIVE IS THE MATERIEL MANAGEMENT OBJECTIVE.

- o IT TIES THE OTHER THREE OBJECTIVES TOGETHER FOR A COORDINATED FOCUS.
- o SIMPLY STATED, WE MUST DEVELOP A SOUND, COOPERATIVE PROCESS WITH INDUSTRY TO EXPLOIT MODERN TECHNOLOGY AND TECHNIQUES.
- o WE REQUIRE HIGHLY INNOVATIVE MANAGEMENT OF ALL OUR RESOURCES.
  - oo MEANS THAT WE ALL HAVE TO WORK CLOSELY AND PROVIDE GOOD INFORMATION FEEDBACK ACROSS ORGANIZATIONAL BOUNDARIES.
- o THIS SLIDE SHOWS THE NECESSITY FOR A CLOSE AND COMPLETE INTERFACE, BETWEEN THE MAN AND THE MACHINE AND THE LOGISTIC SYSTEM THAT BINDS SUPPORTABILITY OF THE MAN AND MACHINE TOGETHER.

(SLIDE 24 OFF)

- o WE THINK IT CAN BE DONE -- WE'VE SEEN PROGRESS.

OTHER CONCERNS
TODAY AND IN THE FUTURE

- DEMOGRAPHY
- PLANNING FACTORS
- STRATEGIC MOBILITY
- EQUIPPING THE FORCE
- TRAINING OF RESERVE COMPONENT
- MANAGEMENT OF FORCE STRUCTURE
- RESERVE COMPONENT LOGISTIC MISSION
- ADEQUACY OF COMBAT SERVICE SUPPORT STRUCTURE
- MOBILIZATION
- SUSTAINABILITY

(SLIDE 25 ON)

OTHER CONCERNS TODAY AND IN THE FUTURE

WHILE FOCUSING ON THE FUTURE AND ON OUR OBJECTIVES, WE MUST KEEP IN MIND OTHER FACTORS WHICH WILL IMPINGE ON OUR ABILITY TO DO THE JOB. FOR EXAMPLE:

- o DEMOGRAPHY
- o THE DECLINING POPULATION OF MILITARY AGE CITIZENS WILL RESULT IN FEWER TROOPS FOR COMBAT SERVICE UNITS, AND A FAR HIGHER PROPORTION OF WOMEN SOLDIERS. FACTORS WHICH MUST BE CONSIDERED IN ANY SOLUTION, BOTH IN FORCE STRUCTURE AND THE KINDS AND QUANTITY OF EQUIPMENT, SUCH AS MATERIEL HANDLING EQUIPMENT.
- o

  RESERVE COMPONENTS HAVE:

  AMMO 90 PERCENT

  POL 80 PERCENT

  MAINT 70 PERCENT
- o MAKE-UP OF THE PROGRAMED FORCE
  - oo 25 PERCENT OF FY 89 KEY LOG UNIT REQUIREMENT UNRESOURCED
  - oo 25 PERCENT OF REQUIREMENT IS HNS
  - oo 14 PERCENT IN ACTIVE COMPONENT
  - oo 36 PERCENT IN RESERVE COMPONENTS (EQUATES TO 72 PERCENT OF U. S. STRUCTURE)

(SLIDE 25 OFF)

LOGISTIC AREAS OF EMPHASIS

- SUPPORT CHARACTERISTICS GIVEN EQUAL CONSIDERATION TO OPERATIONAL CHARACTERISTICS DURING LIFE CYCLE DEVELOPMENT
- FAMILIES OF VEHICLES AND EQUIPMENT WITH STANDARD, INTERCHANGEABLE COMPONENTS
- EQUIPMENT SIMPLE TO OPERATE AND MAINTAIN
- REDUCE NUMBER OF LINE ITEMS AND ITEMS TO BE STOCKED
- REDUCE BULK AND WEIGHT OF EQUIPMENT RATIONS, AMMO, AND FUEL
- LOGISTIC AUTOMATION AND COMMUNICATIONS ON THE BATTLEFIELD
- IMPROVED TRANSPORTABILITY CONTAINERIZATION, PACKAGING AND MATERIEL HANDLING

REDUCE LOGISTIC CONSTRAINTS, THROUGH TECHNOLOGY, ON THE AIRLAND BATTLEFIELD

(SLIDE 26 ON)

LOGISTIC AREAS OF EMPHASIS.

- o IN SUMMARY, THEN, WE NEED TO EMPHASIZE CERTAIN AREAS TOWARDS WHICH WE CAN FOCUS LOGISTICS RESEARCH AND DEVELOPMENT.
- o OTHER SPEAKERS WILL PROVIDE SPECIFICS ON THE ARMY LOGISTICS R & D PROGRAM.
- o FOR MY PART, WE NEED TO --
  - oo ENSURE THAT "SUPPORTABILITY" IS CONSIDERED THROUGHOUT THE RDTE PROCESS - NOT JUST AT THE END
  - oo REQUIRE DEVELOPERS TO USE COMMON PARTS AND SPECIFICATIONS WHENEVER POSSIBLE
  - oo REDUCE BULK AND WEIGHT WHEREVER POSSIBLE
  - oo PLACE LOGISTICS COMMUNICATIONS AND DATA TRANSMISSION EQUIPMENT ON A PAR WITH OPERATIONS COMMUNICATIONS EQUIPMENT
- o IN SHORT, TRANSFORM LOGISTICS FROM AN "OPERATIONS CONSTRAINT" TO A "FORCE MULTIPLIER"
- o THE SLIDES THAT FOLLOW ARE EVEN MORE SPECIFIC

(SLIDE 26 OFF)

LOGISTICS NEEDS

MATERIEL NEEDS -

- EQUIPMENT WHICH IS:
  - RELIABLE, AVAILABLE, AND MAINTAINABLE
  - SELF RECOVERABLE
  - STANDARD DESIGN/MODULAR COMPONENTS
  - MAKES MAXIMUM USE OF COMMERCIALLY AVAILABLE ITEMS/COMPONENTS

DISTRIBUTION NEEDS -

- NON-TERRAIN RESTRICTED TRANSPORT CAPABILITY
- REMOTELY PILOTED VEHICLES/DRONES
- IMPROVED TRANSPORTATION MOVEMENTS CONTROL SYSTEM

MAINTENANCE SUPPORT NEEDS -

- REDUCE MANPOWER INTENSIVE
- REPLACE FORWARD- REPAIR REAR
- THREE LEVELS

LOGISTICS NEEDS (CONT)

SUPPLY NEEDS -

- ALTERNATIVES FOR CL III, AND V WHICH DRASTICALLY REDUCE, OR EVEN ELIMINATE RESUPPLY REQUIREMENTS
- DECREASE MANPOWER REQUIREMENTS FOR DISTRIBUTION AND HANDLING OF POL AND AMMO

MATERIEL MANAGEMENT NEEDS -

- REAL TIME ASSET REPORTING
- ACTUAL ASSET LOCATION SYSTEMS
  - MAJOR ITEMS
  - PARTS/SUPPLIES
  - RESPONSIVE, PAPERLESS, DISTRIBUTION SYSTEM
- FLEXIBLE MODELS
  - TO PREDICT SUPPORT REQUIREMENTS
  - TO PREDICT SUPPORT UNIT REQUIREMENTS

(SLIDE 27 ON)

SLIDES 27 AND 28 ARE A LIST OF "LOGISTICS NEEDS".

- o TO RE-CAP, HERE ARE SOME OF THE LOGISTICS NEEDS THAT MUST BE SATISFIED FOR US TO SUPPORT THE ARMY OF THE 21ST CENTURY.
  - oo (PAUSE - ALLOW APPROX 15 SEC READING TIME PER SLIDE)
- o EACH OF THESE AREAS OFFERS POTENTIALS FOR THE APPLICATION OF LOGISTICS TECHNOLOGY AND IR&D.

(SLIDE 28 OFF)

SLIDE 29

LTG THOMPSON - FM ROMMEL QUOTE

- o LET ME CONCLUDE WITH THESE WORDS
  - oo THE TACTICIAN IS A MAN WHO KNEW A GREAT DEAL ABOUT COMBAT - FIELD MARSHAL ERWIN ROMMEL.
  - oo THE LOGISTICIAN IS A MAN WHO KNOWS A LOT ABOUT LOGISTICS - LTG Richard Thompson, the DCSLOG.
- o IF THE ARMY OF THE 1995 - 2030 TIME FRAME IS TO BE CAPABLE OF DEFENDING THE UNITED STATES --
  - oo IT MUST BE CABABLE OF BEING LOGISTICALLY SUPPORTED.
- o AND OUR LOGISTIC SUPPORT BEGINS WITH YOUR IDEAS AND EQUIPMENT.
- o TOGETHER WE CAN DO THE JOB.
- o THANK YOU

A LOGISTICIAN'S VIEW

"LOGISTICS CANNOT BE A CONSTRAINT TO THE SUCCESSFUL ACCOMPLISHMENT OF THE MISSION AND OBJECTIVES OF COMMANDERS IN THE FIELD."

A TACTICIAN'S VIEW

"THE BRAVEST MAN CAN DO NOTHING WITHOUT GUNS, NOTHING WITHOUT AMMUNITION - AND GUNS AND AMMUNITION ARE OF LITTLE USE IN MOBILE WARFARE UNLESS THEY CAN BE TRANSPORTED BY VEHICLES SUPPLIED WITH SUFFICIENT FUEL AND WATER."

OVERVIEW OF SELECTED TOPICS IN LOGISTICS R&D

Wilson Heaps
Army Materiel Systems Analysis Activity

OVERVIEW OF SELECTED TOPICS AND METHODOLOGY NEEDED

IN

LOGISTICS R & D

PRESENTED

ARO WORKSHOP ON

ANALYTICAL AND COMPUTATIONAL

ISSUES IN LOGISTICS R & D

8 MAY 1984

TOPICS

- SPARC/APPLICATIONS

  NEED: QUICK SPARC METHOD

- MOBSIM

  NEED: EFFICIENT METHODS FOR ESTIMATING RESOURCE REQUIREMENTS AND READINESS

- TMDE REQUIREMENTS

  NEED: QUANTITATIVE METHODS FOR DEVELOPING DEFENDABLE REQUIREMENTS

SUSTAINABILITY PREDICTIONS FOR ARMY SPARE COMPONENT REQUIREMENTS FOR COMBAT (SPARC)

SPARC OBJECTIVE

ENHANCE COMBAT SUSTAINABILITY OF CRITICAL SYSTEMS BY:

1. PREDICTING PARTS THAT WILL BE DAMAGED IN COMBAT.
2. PRODUCT IMPROVING THESE PARTS, WHERE FEASIBLE.
3. DEVELOPING FIELD EXPEDIENTS AND COMBAT DAMAGE REPAIR PROGRAMS.

SPARC METHODOLOGY

TARGET DESCRIPTION

THREAT IDENTIFICATION

ASSESSMENT OF INDIVIDUAL THREATS

RESULTING DATA TYPES

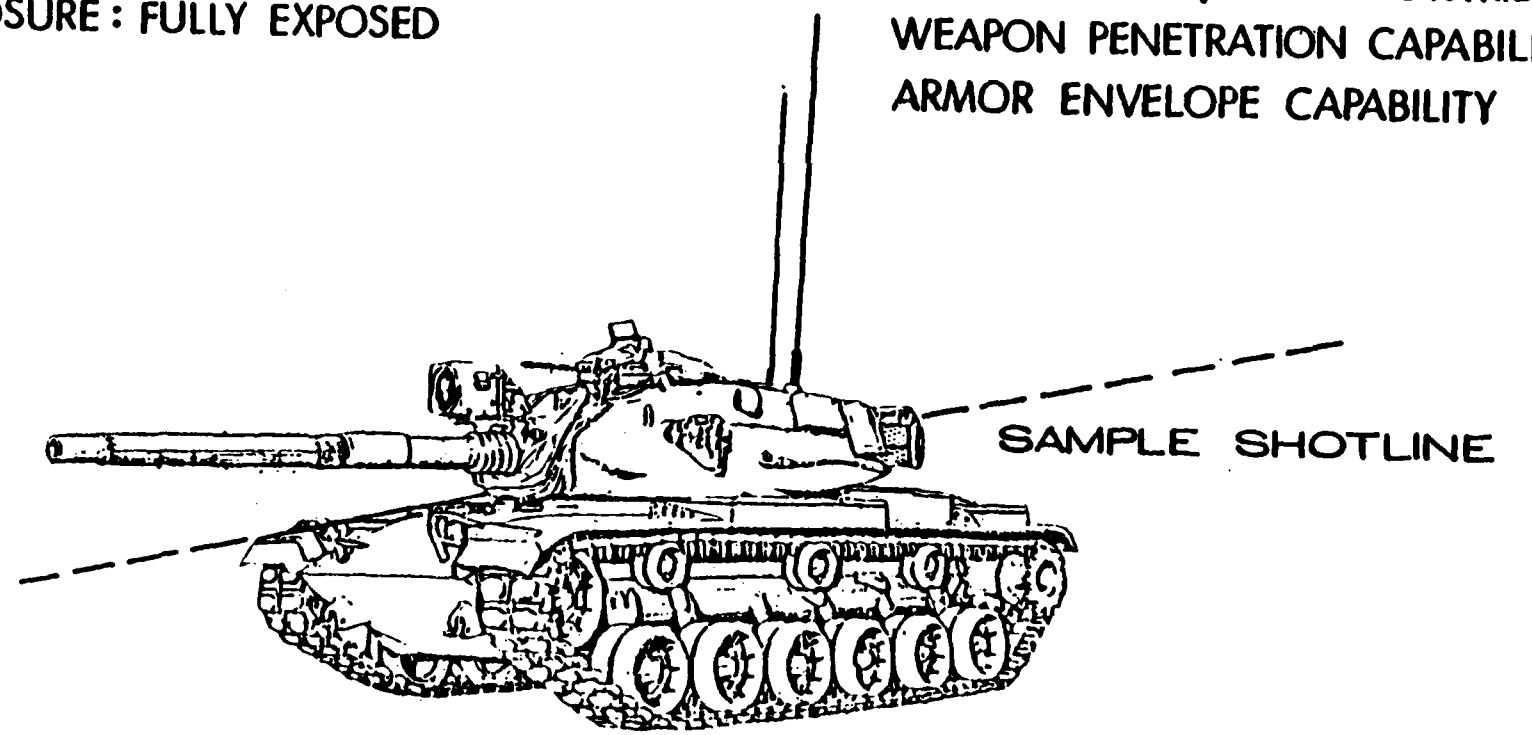
ASSESS EFFECT OF WEAPON VS TARGET FOR "SPECIFIC" CONDITION

CONDITION :

TARGET : M60A1
WEAPON : 125MM KE
RANGE : 1500 M
EXPOSURE : FULLY EXPOSED

CONSIDERATIONS

WEAPON ACCURACY
AIM POINT
ATTACK ANGLE (CARDIOID DISTRIBUTION)
WEAPON PENETRATION CAPABILITY
ARMOR ENVELOPE CAPABILITY



PRODUCT A "POT" OF EFFECTS DATA FOR THE SPECIFIED CONDITION

CONDITION

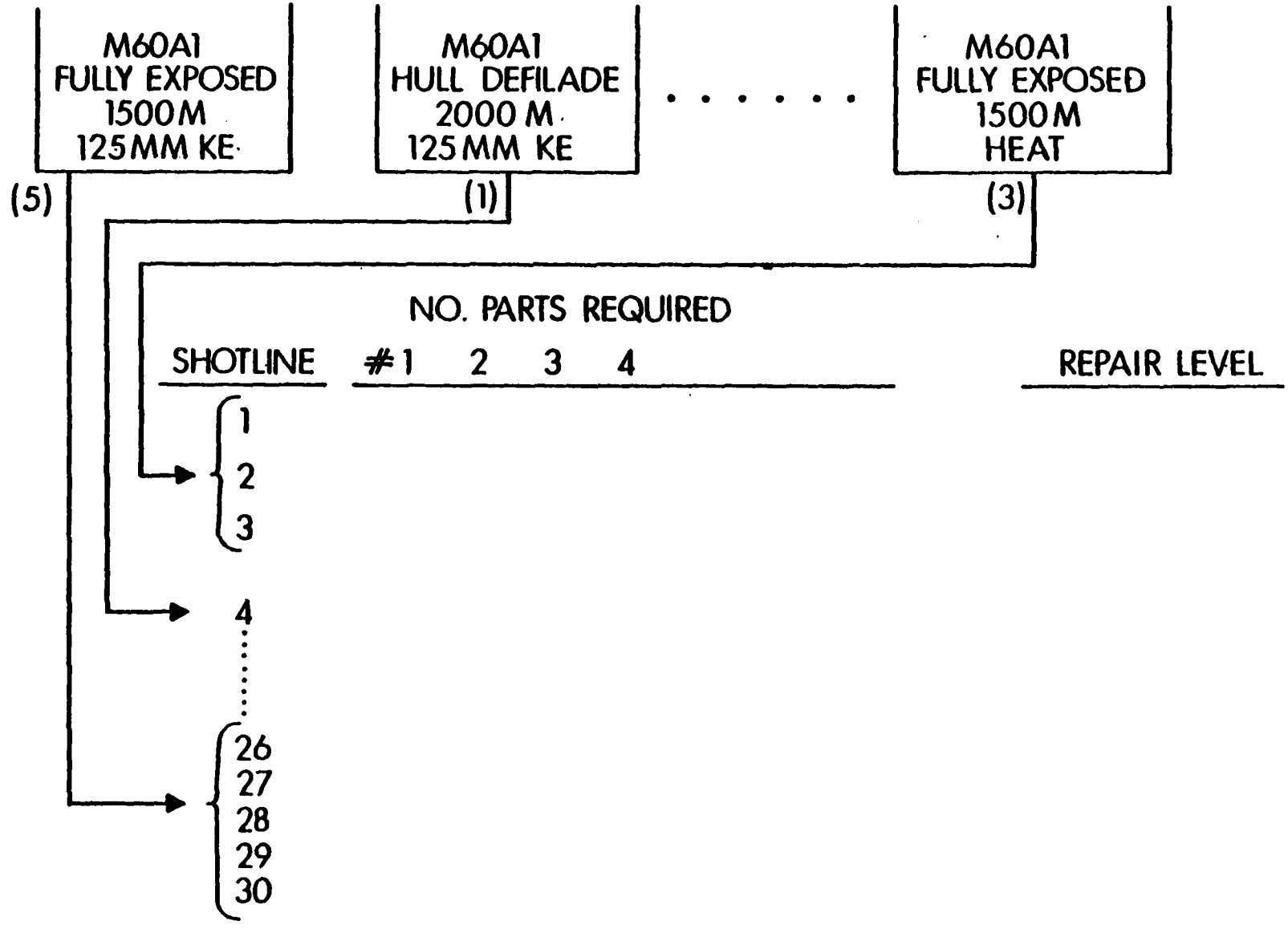
TARGET : M60
WEAPON : 125MM KE
RANGE : 1500 M
EXPOSURE : FULLY EXPOSED

EXAMPLE RESULTING DATA BIN
(CONTAINS ONLY NON-K KILL SHOTLINES)

SHOTLINE NUMBER	PROB. OF OCCURRENCE	NUMBER OF PARTS REQD PART # 1	2	3	4	.....	REPAIR LEVEL	AND TIME
1	.0062	3	0	0	1		ORG	2.4
2	.0013	0	0	2	1		DS	1.3
3	.0009	1	1	1	0	.....	GS	7.6
.	.	.	.	.	.		.	
.	.	.	.	.	.		.	
.	.	.	.	.	.		.	

PARTS REQUIRED TO REPAIR COMBAT DAMAGE

DRAW SAMPLE SHOTLINES FROM BINS IDENTIFIED



CONVERSION OF RESULTS TO "FAILURE FACTORS"

LET FF(CD) BE THE NUMBER OF A PARTICULAR PART REQUIRED FOR REPAIR OF COMBAT DAMAGE TO A SYSTEM, PER 100 SYSTEMS PER YEAR.

EXAMPLES:

- 1220-01-019-4548 LZR RNGE FINDER $49,300

$$\frac{\text{216 RNGE FINDERS}}{\text{67,632 TANK DAYS}} \doteq \frac{\text{FF(CD)}}{\text{36,500 TANK DAYS}} \; ; \; \text{FF(CD)} = 117 \qquad \text{FFII} = 10$$

- 2590-01-022-5578 TURRET CNTRL HARNESS $139

$$\frac{\text{321 HARNESSES}}{\text{67,632 TANK DAYS}} = \frac{\text{FF(CD)}}{\text{36,500 TANK DAY}} \; ; \; \text{FF(CD)} = 173 \qquad \text{FFII} = 4$$

- INTENSE PERIOD - FIRST 60 DAYS
- NEED TO EXPAND TO FULL 180 DAY SCENARIO
- SCALING FACTORS NEEDED

SPARC APPLICATIONS

- MARC (IMPROVED MACRIT)
- MOST FREQUENTLY DAMAGED COMPONENTS/HARDENING/BATTLEFIELD EXPEDIENT REPAIRS
- INCORPORATION OF COMBAT DAMAGE INTO STANDARD PROVISIONING METHODS
  - STANDARDIZED COMBAT ASL
  - PROTOTYPE WAR RESERVES COMPUTATIONS W/TACOM
- ARMOR CREW CASUALTY ANALYSIS

NEED: A QUICK, EASILY IMPLEMENTABLE METHOD FOR ESTIMATING COMPONENT DAMAGE FREQUENCIES FOR SYSTEMS WHICH CANNOT BE SUBJECTED TO A THOROUGH SPARC ANALYSIS.

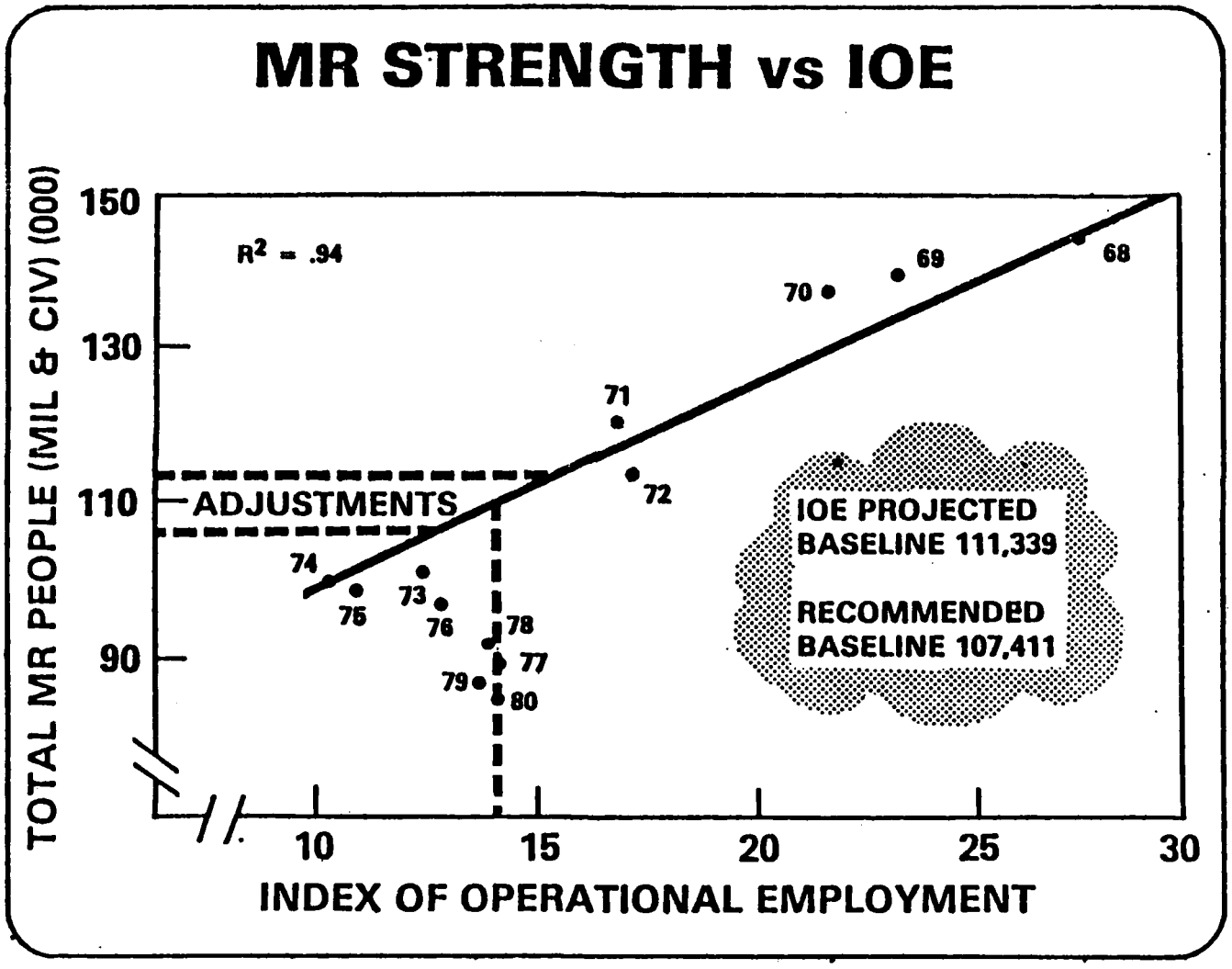
DARCOM

MOBILIZATION SIMULATION

MODEL

(MOBSIM)

BACKGROUND



FROM: DARCOM BASELINE STUDY

MOBSIM

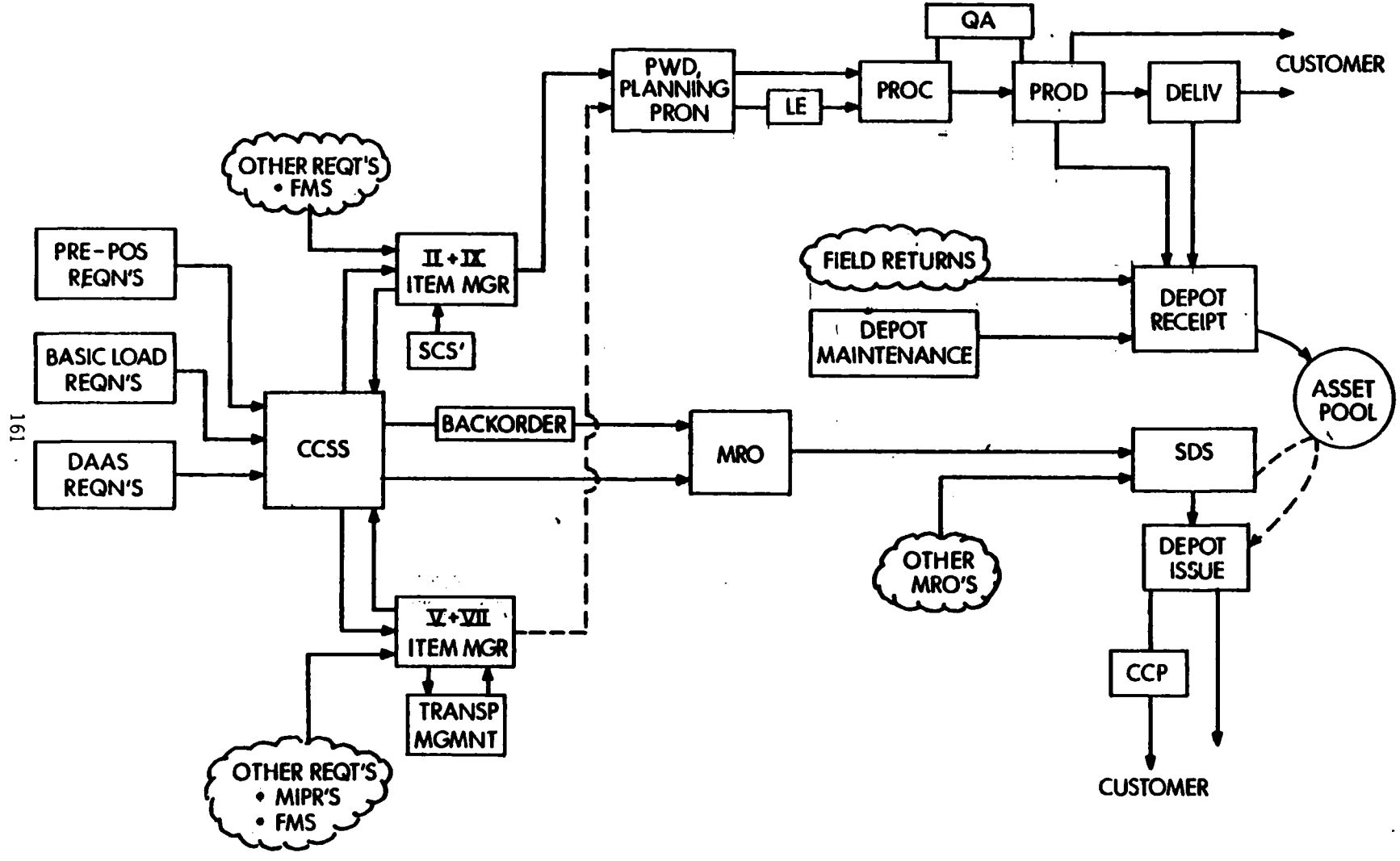
WHAT IS IT?

- O SIMULATION
- O REQUISITION DRIVEN ACTIVITIES OF DARCOM CENTRAL SUPPLY SYSTEM
- O SUPPLY CLASSES II,V,VII AND IX

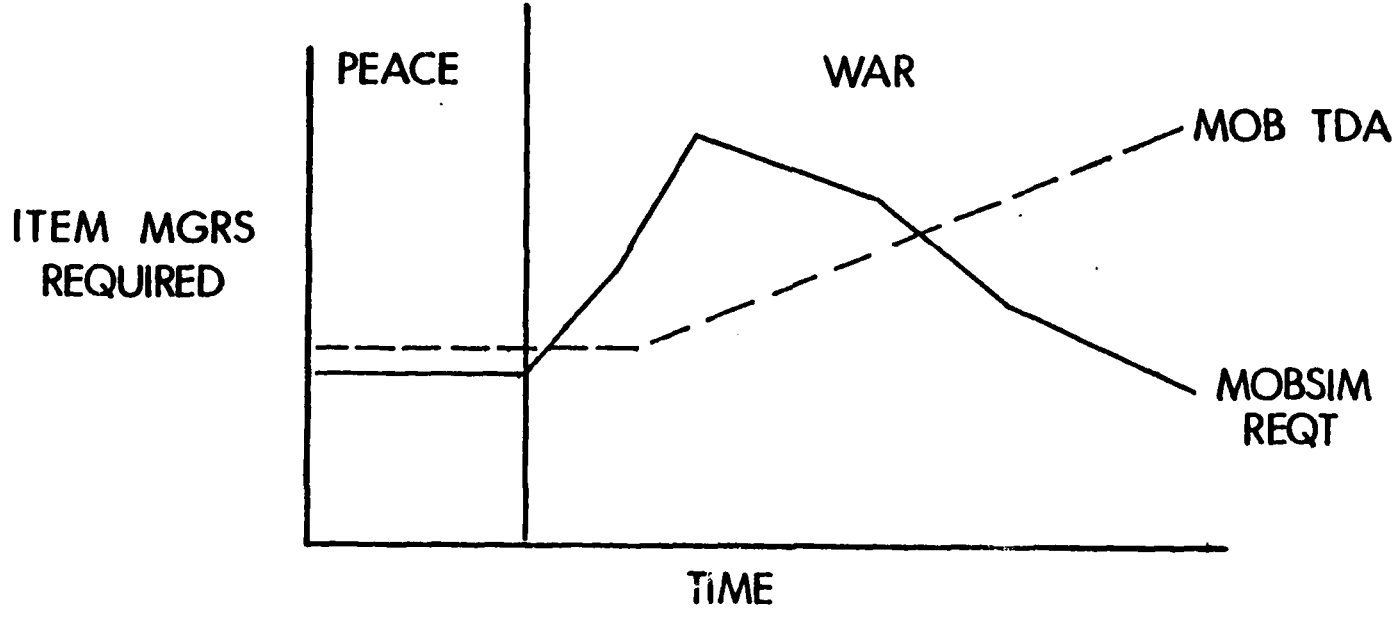
WHAT ARE ITS GOALS?

- O TO ESTIMATE RESOURCES REQUIRED OVER TIME BY MODELED ACTIVITIES TO SUPPORT PEACETIME OR PEACE TO MOB TO WAR ACTIVITIES
- O TO ESTIMATE DARCOM'S CAPABILITY TO PROVIDE THE SUPPLY SUPPORT IDENTIFIED AS REQUIRED BY OPLANS, EXERCISES, COMBAT ANALYSES, ETC.

MODEL DESCRIPTION –
NETWORK & NODAL INTERCONNECTIONS

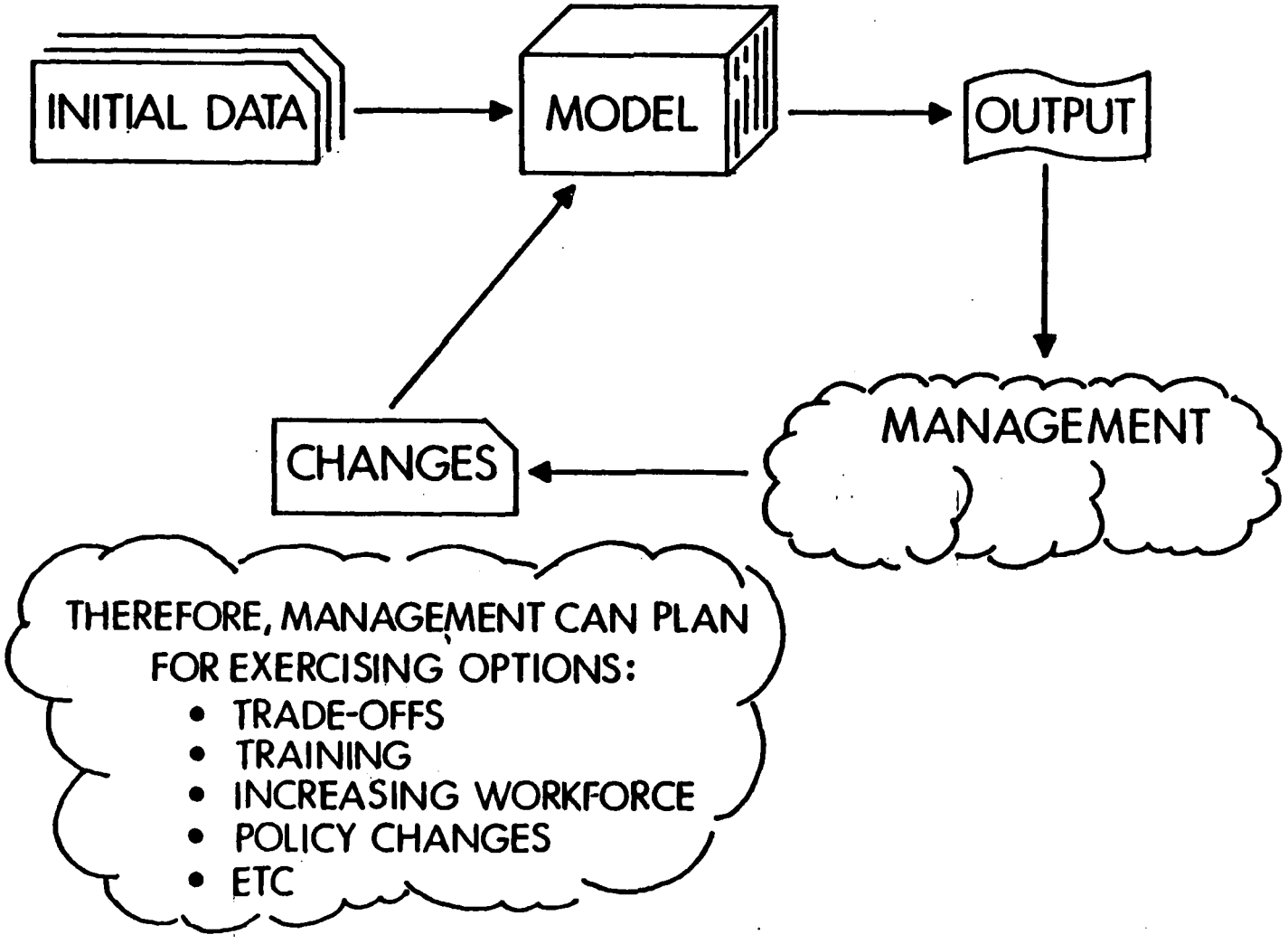


NOTIONAL OUTPUT GRAPHIC REPRESENTATION



MOBSIM

MANAGEMENT ROLE



TEST MEASUREMENT AND DIAGNOSTIC

EQUIPMENT (TMDE) REQUIREMENTS ESTABLISHMENT

TMDE REQUIREMENTS

- RESPONSE TO "UNDER" QUESTION -

  "IMPACTS OF NOT MEETING REQUIREMENTS"

- HOW ARE REQUIREMENTS CURRENTLY ESTABLISHED?

- HOW ARE WE DOING?

  SURVEY OF SELECTED SYSTEMS

NEED: DEFENDABLE METHODS FOR ESTABLISHING TMDE PERFORMANCE REQUIREMENTS.

SUPPORTABILITY IN OPERATIONAL TEST AND EVALUATION

Douglas McGowen
Operational Test and Evaluation Agency

ISSUE

OPERATIONAL AVAILABILITY AS DEFINED IN AR 702-3 IS NOT A GOOD INDICATOR OF WARTIME (COMBAT) READINESS OR AVAILABILITY

OPERATIONAL AVAILABILITY
(AR 702-3)

THE PROPORTION OF TIME A SYSTEM IS EITHER OPERATING OR IS CAPABLE OF BEING OPERATED, WHEN USED IN A SPECIFIC MANNER IN A TYPICAL MAINTENANCE AND SUPPLY ENVIRONMENT. ALL CALENDAR TIME IS CONSIDERED.

OPERATIONAL AVAILABILITY
(AR 702-3)

OT = THE OPERATING TIME DURING A GIVEN CALENDAR TIME PERIOD

TCM = THE TOTAL CORRECTIVE MAINTENANCE DOWN TIME IN CLOCK HOURS DURING THE GIVEN PERIOD

ST = STANDBY TIME (NOT OPERATING, BUT ASSUMED OPERABLE) PER GIVEN CALENDAR TIME PERIOD

TPM = THE TOTAL PREVENTIVE MAINTENANCE DOWN TIME IN CLOCK HOURS DURING THE STATED OT PERIOD

TALDT = TOTAL ADMINISTRATIVE AND LOGISTICS DOWN TIME SPENT WAITING FOR PARTS, MAINTENANCE PERSONNEL, OR TRANSPORTATION PER GIVEN CALENDAR TIME PERIOD

OPERATIONAL AVAILABILITY (ARINC)

THE PROBABILITY THAT THE SYSTEM IS OPERATING SATISFACTORILY AT ANY POINT IN TIME WHEN USED UNDER STATED CONDITIONS, WHERE THE TOTAL TIME CONSIDERED INCLUDES OPERATING TIME, ACTIVE REPAIR TIME, ADMINISTRATIVE TIME AND LOGISTICS TIME

OPERATIONAL AVAILABILITY (ARINC)

OT = THE TIME DURING WHICH THE SYSTEM IS OPERATING IN A MANNER ACCEPTABLE TO THE OPERATOR

ART = THE PORTION OF DOWN TIME DURING WHICH ONE OR MORE TECHNICIANS ARE WORKING ON THE SYSTEM TO EFFECT A REPAIR

LT = THE PORTION OF DOWN TIME DURING WHICH REPAIR IS DELAYED SOLELY BECAUSE OF THE NECESSITY FOR WAITING FOR A REPLACEMENT PART OR OTHER SUBDIVISION OF THE SYSTEM.

AT = THE PORTION OF DOWN TIME NOT INCLUDED UNDER ACTIVE REPAIR TIME AND LOGISTICS TIME

OPERATIONAL READINESS
(ARINC)

THE PROBABILITY THAT, AT ANY POINT IN TIME, THE SYSTEM IS EITHER OPERATING SATISFACTORILY OR READY TO BE PLACED IN OPERATION ON DEMAND WHEN USED UNDER STATED CONDITIONS, INCLUDING STATED ALLOWABLE WARNING TIME. THUS, TOTAL CALENDAR TIME IS THE BASIS FOR COMPUTATION OF OPERATIONAL READINESS.

OPERATIONAL READINESS (ARINC)

OT = THE TIME DURING WHICH THE SYSTEM IS OPERATING IN A MANNER ACCEPTABLE TO THE OPERATOR.

ART = THE PORTION OF DOWN TIME DURING WHICH ONE OR MORE TECHNICIANS ARE WORKING ON THE SYSTEM TO EFFECT A REPAIR.

LT = THE PORTION OF DOWN TIME DURING WHICH REPAIR IS DELAYED SOLELY BECAUSE OF THE NECESSITY FOR WAITING FOR A REPLACEMENT PART OR OTHER SUBDIVISION OF THE SYSTEM.

AT = THE PORTION OF DOWN TIME NOT INCLUDED UNDER ACTIVE REPAIR TIME AND LOGISTICS TIME.

FT = THE TIME DURING WHICH OPERATIONAL USE OF THE SYSTEM IS NOT REQUIRED. THIS TIME MAY OR MAY NOT BE DOWN TIME, DEPENDING ON WHETHER OR NOT THE SYSTEM IS IN OPERABLE CONDITION.

ST = THE TIME WHICH THE SYSTEM IS PRESUMED TO BE IN OPERABLE CONDITION , BUT IS BEING HELD FOR EMERGENCY I.E. AS A SPARE.

OPERATIONAL AVAILABILITY (IRESON)

THE PROBABILITY THAT IT IS OPERATING SATISFACTORILY AT ANY POINT IN TIME WHEN USED UNDER STATED CONDITIONS. OPERATIONAL AVAILABILITY CONSIDERS OPERATE AND TOTAL DOWN TIME.

OPERATIONAL AVAILABILITY
(IRESON)

OT = OPERATE TIME

TDT = TOTAL DOWN TIME

OPERATIONAL READINESS (IRESON)

THE PROBABILITY THAT AT ANY POINT IN TIME A SYSTEM OR EQUIPMENT IS EITHER OPERATING SATISFACTORILY OR READY TO BE PLACED IN OPERATION ON DEMAND WHEN USED UNDER STATED CONDITIONS, INCLUDING STATED ALLOWABLE WARNING TIME

NOTES FROM ARINC

- OPERATIONAL READINESS CAN BE ENHANCED BY USING FREE TIME FOR MAINTENANCE
- FREE TIME CAN COMPENSATE TO SOME EXTENT FOR POOR RELIABILITY AND POOR MAINTAINABILITY
- FREE TIME AND STORAGE TIME ALLEVIATE THE EFFECTS OF EQUIPMENT INADEQUACIES AND GAIN OPERATIONAL READINESS
- FREE TIME AND STORAGE TIME HAVE NO CONNECTION WITH IMPROVING EQUIPMENT

NOTES FROM IRESON

CAN HAVE HIGH READINESS ON EQUIPMENT OPERATING FOR SHORT PERIODS AND HAVING LONG OFF TIME

OPERATIONAL AVAILABILITY
(AR 702-3)

AR 702-3 DEFINITION OF OPERATIONAL AVAILABILITY IS:

- NOT CONSISTENT WITH LITERATURE DEFINITION
- LITERATURE DEFINITION OF OPERATIONAL READINESS
- DIFFICULT TO EVALUATE IN TEST
- INSENSITIVE TO LARGE BLOCKS OF STAND BY TIME

EXAMPLE OF AR 702-3
OPERATIONAL AVAILABILITY

OT = 288 HRS

TCM = 94 HRS

TPM = 16 HRS

TALOT = 152 HRS

ST = 8210 HRS

$$A_o = \frac{288 + 8210}{288 + 8210 + 94 + 16 + 152} = \frac{8498}{8760} = .97$$

$$A_o = \frac{7922}{8472} = .94$$

$$\triangle A_o = .03$$

EXAMPLE OF ARINC OPERATIONAL AVAILABILITY

$$A_O = \frac{288}{288 + 94 + 16 + 152} = .53$$

SUGGESTED WARTIME OPERATIONAL AVAILABILITY

THE PORTION OF TIME A SYSTEM IS EITHER OPERATING OR CAPABLE OF BEING OPERATED WHEN OPERATED UNDER GIVEN CONDITIONS AND SUPPORTED IN A WARTIME SUPPORT ENVIRONMENT. THE TIME CONSIDERED IS MISSION OPERATE TIME, MISSION STANDBY TIME, NON DEFERABLE MISSION CRITICAL MAINTENANCE (CORRECTIVE AND PREVENTIVE), AND MISSION CRITICAL ADMINISTRATIVE AND LOGISTICS DOWNTIME.

SUGGESTED WARTIME OPERATIONAL AVAILABILITY

OT = OPERATING TIME STATED IN THE MISSION PROFILE AND OPERATIONAL MODE SUMMARY

MST = MISSION STANDBY TIME IN THE MISSION PROFILE AND OPERATIONAL MODE SUMMARY

MCCM = MISSION CRITICAL CORRECTIVE MAINTENANCE

MCPM = MISSION CRITICAL PREVENTIVE MAINTENANCE

MCALDT = MISSION CRITICAL ADMINISTRATIVE AND LOGISTICS DOWNTIME

ADVANTAGES OVER AR 702-3 OPERATIONAL AVAILABILITY

- MORE REFLECTIVE OF THE CAPABILITY TO "FIGHT SYSTEM" OVER TIME
- ELIMINATES INSENSITIVITY TO LARGE BLOCKS OF STANDBY TIME
- PROVIDES A MORE REALISTIC ESTIMATE OF WARTIME MAINTENANCE
- EASIER TO EVALUATE FROM TEST DATA

ILS QUANTIFICATION

Thomas Lanagan
Army Logistics Center

TITLE: Risk Assessment Procedures for Quantifying Integrated Logistics Support (ILS) Product Development

AUTHORS: Mr. Charles Santilli and Mr. Thomas Lanagan (presentation to be given by Mr. Lanagan)

ORGANIZATION: Commander
US Army Logistics Center
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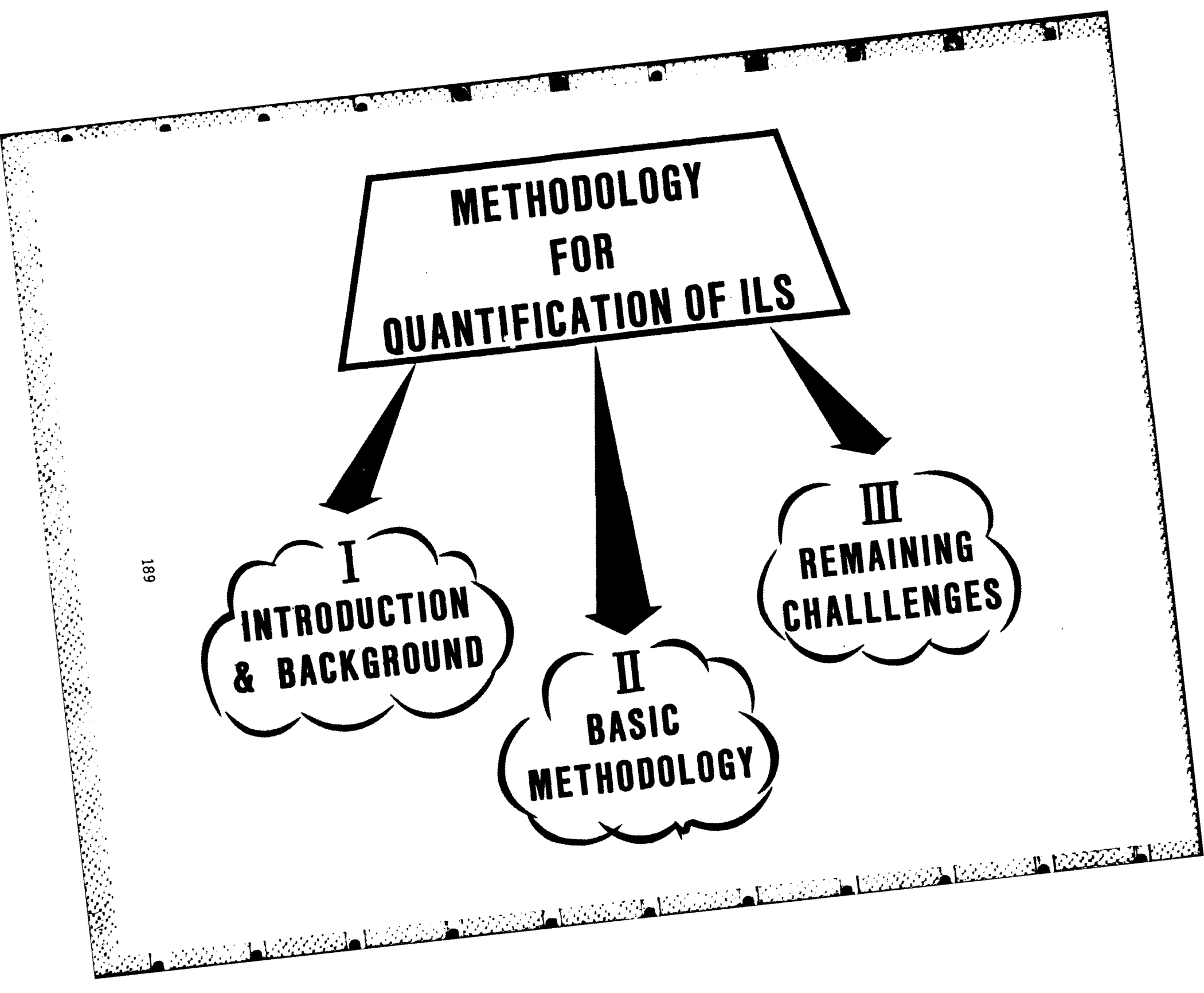
ABSTRACT: The thrust of the paper is to develop an approach which quantifies ILS assessments and which provides a measure of risk in terms of the system meeting logistic objectives at the time of fielding. The proposed process provides as objectives a performance envelope which varies over time and which takes into account learning curve phenomena and hardware/software improvements. This permits demonstrated performance to be tracked against a specified performance envelope as well as to have future performance forecasted. In assessing the applicability of risk assessment to ILS quantification, the methodology was designed so as to complement the MIL Standard 1388-1A and the Logistic Support Analysis (LSA) Process. This was accomplished by developing risk assessment procedures for use under two modes. First, the process could be employed as a PMO management tool to assess ILS Product Development in terms of cost and schedule which represents a classical use of risk assessment. Alternatively, risk assessment can be employed to assess the impacts which ILS Product Performance has upon the Army in the field. The second mode represents an application of risk assessment procedures which has not received extensive application in the past. In summary, the paper describes a methodology which provides for a systematic review of all 15 assessment areas (defined under AR 700-127) and which weights them by their wartime criticality. This process synthesizes available data with current expert insight into an overall system review which quantifies impacts in terms of resource shifts, operating and support cost deltas, and availability changes.

CLASSIFICATION OF PAPER: Unclassified


METHODOLOGY
FOR
QUANTIFICATION OF ILS
I
INTRODUCTION
& BACKGROUND
II
BASIC
METHODOLOGY
III
REMAINING
CHALLLENGES

METHODOLOGY FOR QUANTIFICATION OF ILS

- INTRODUCTION AND BACKGROUND — MR. SANTILLI, MSD
- BASIC METHODOLOGY — MR. LANAGAN, OAD
- REMAINING CHALLENGES — MR. SANTILLI, MSD

QUANTIFICATION OF ILS

OBJECTIVES

DEVELOP METHODOLOGY → MEASURE THE LIKELIHOOD OF ATTAINING ILS OBJECTIVES

MATERIEL ACQUISITION PROCESS → QUANTIFY THE SYSTEM SUPPORTABILITY IMPACTS ON THE ARMY IN THE FIELD

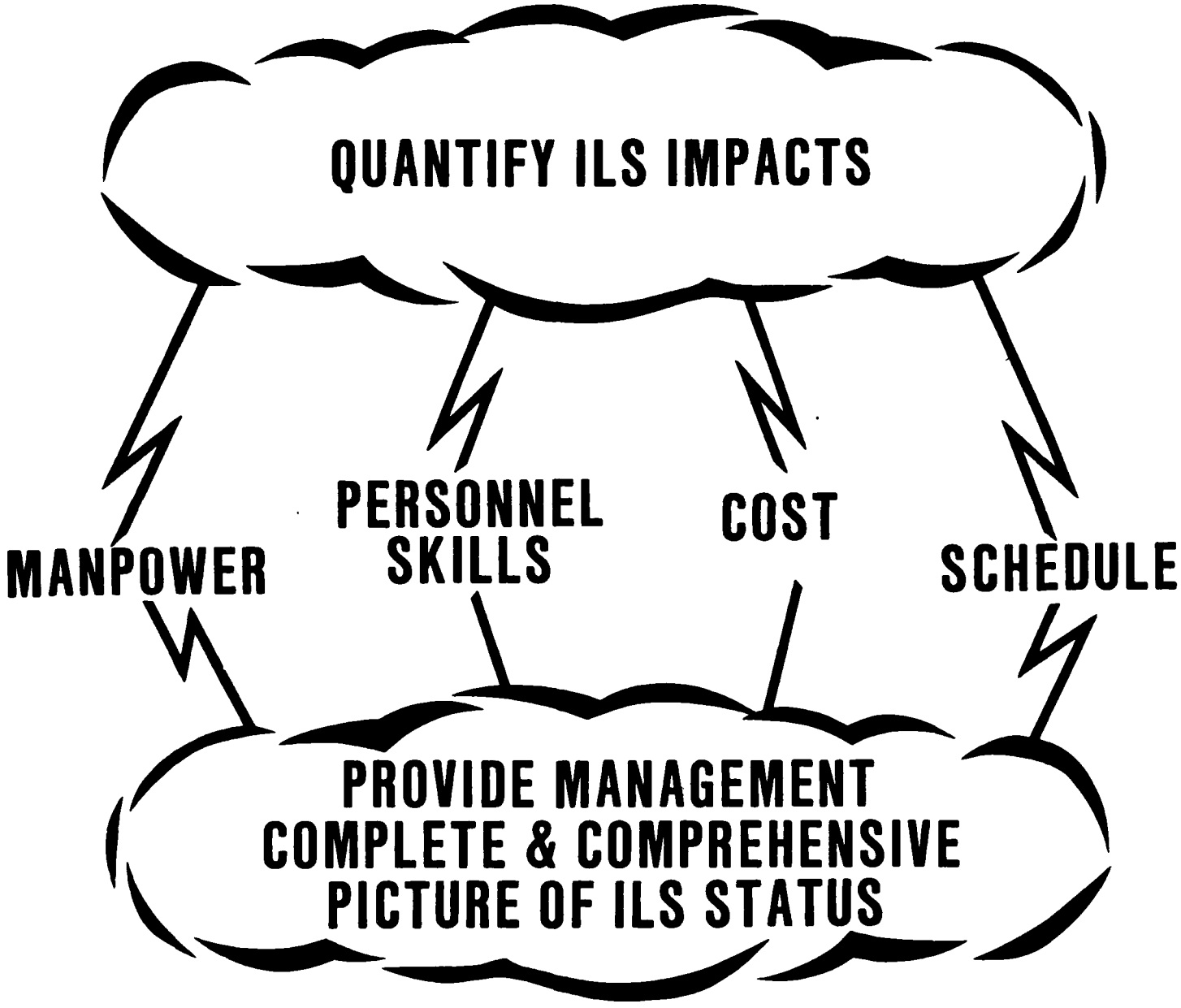
RED

QUANTIFICATION OF ILS OBJECTIVES

* QUANTIFICATION OF ILS WILL ACCOMPLISH TWO BASIC FUNCTIONS FOR THE ARMY

  ** MEASURE THE LIKELIHOOD OF ATTAINING THE ILS OBJECTIVES

  ** QUANTIFY THE SUPPORTABILITY IMPACTS ON THE ARMY IN THE FIELD


QUANTIFY ILS IMPACTS
MANPOWER
PERSONNEL SKILLS
COST
SCHEDULE
PROVIDE MANAGEMENT COMPLETE & COMPREHENSIVE PICTURE OF ILS STATUS

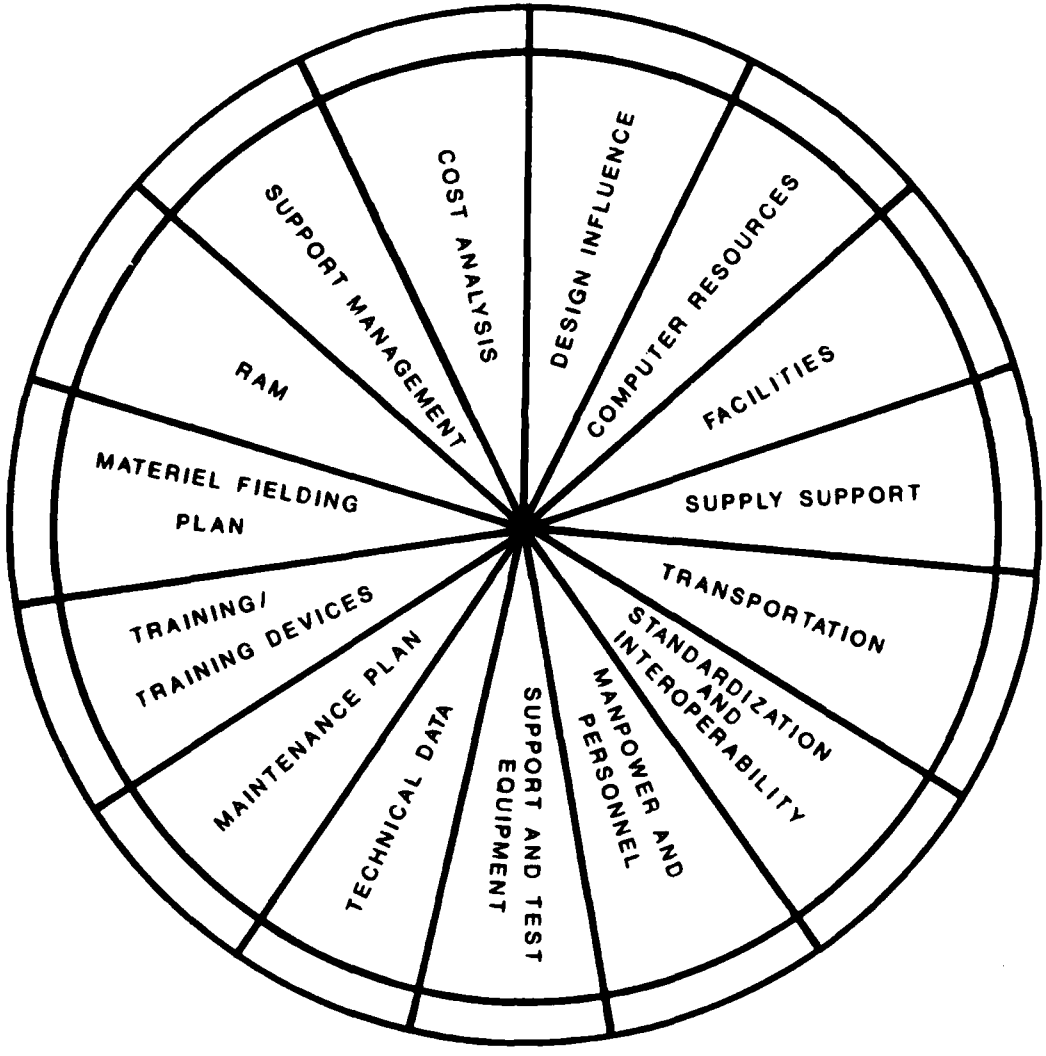
QUANTIFY ILS IMPACTS

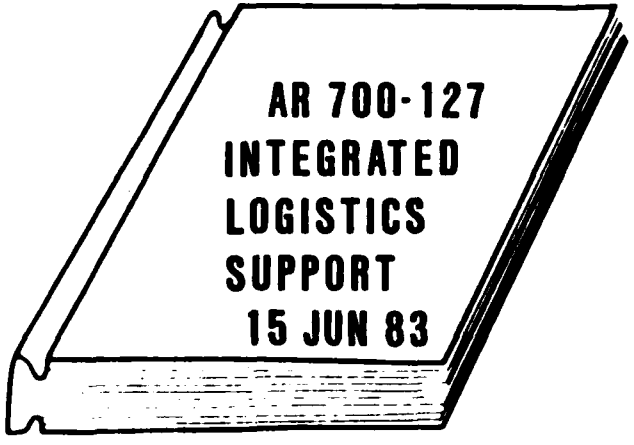
** METHODOLOGY MUST PRESENT ILS QUANTITATIVE IMPACTS ON PROGRAM

*** COST
*** SCHEDULE
*** ADDITIONAL RESOURCES REQUIRED FOR REALIGNMENT (SUPPORT CATCH-UP)

** PROVIDE LOGISTICS MANAGERS AND ACQUISITION DECISION MAKERS A COMPLETE AND COMPREHENSIVE PICTURE OF THE ILS STATUS

15 ILS ASSESSMENT CONSIDERATIONS





15 ILS ASSESSMENT CONSIDERATIONS

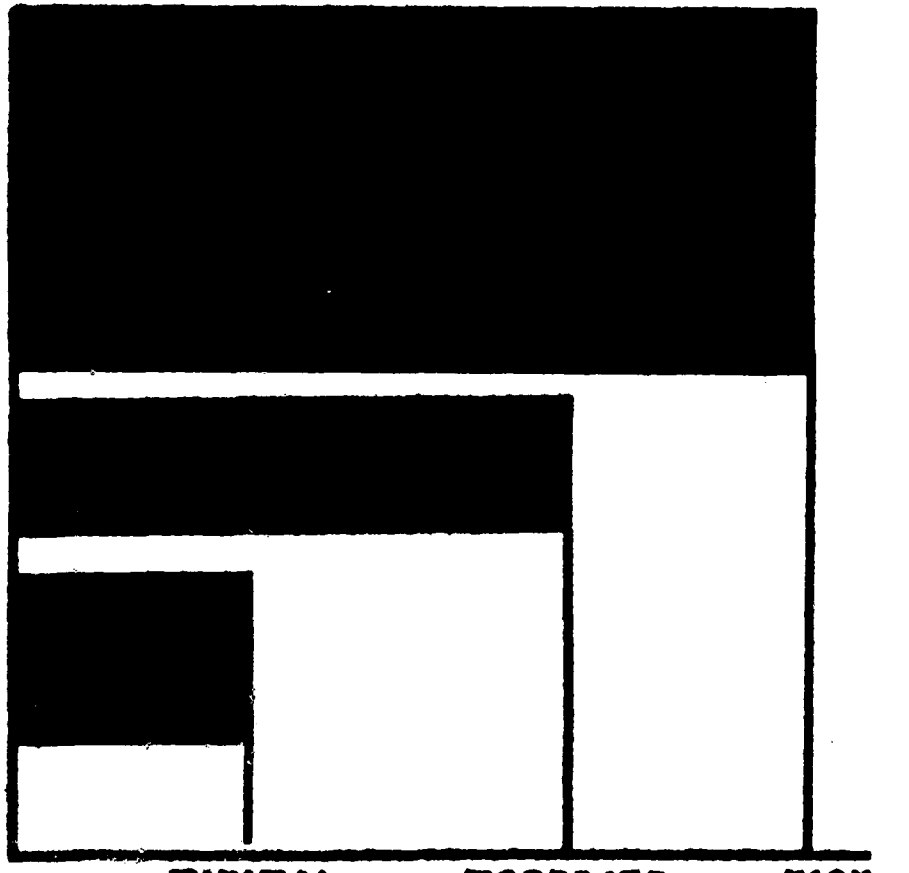
THE CONCEPT FOR QUANTIFYING ILS IS BASED UPON 15 ASSESSMENT CONSIDERATIONS ESTABLISHED IN AR 700-127

DEGREE OF QUANTIFICATION OF THE 15 ILS ASSESSMENT CONSIDERATIONS

MAINTENANCE PLANNING
SUPPORT/TEST EQUIPMENT
SUPPLY SUPPORT
TRANSPORTATION/TRANSPORTABILITY
MANPOWER & SKILLS
DESIGN INFLUENCE
RAM
COST ANALYSIS

TECHNICAL DATA
TRAINING & TRAINING DEVICES
FACILITIES

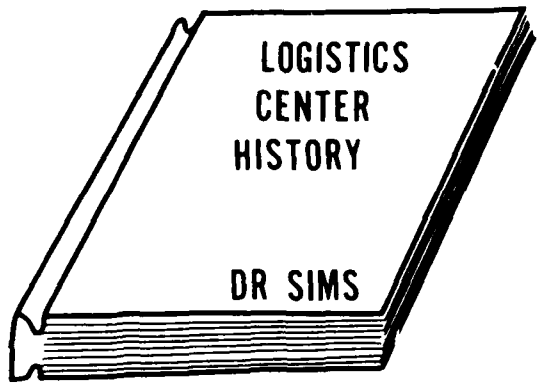
COMPUTER RESOURCES SUPPORT
MATERIEL FIELDING PLANNING
STANDARDIZATION/INTEROPERABILITY
SUPPORT MANAGEMENT

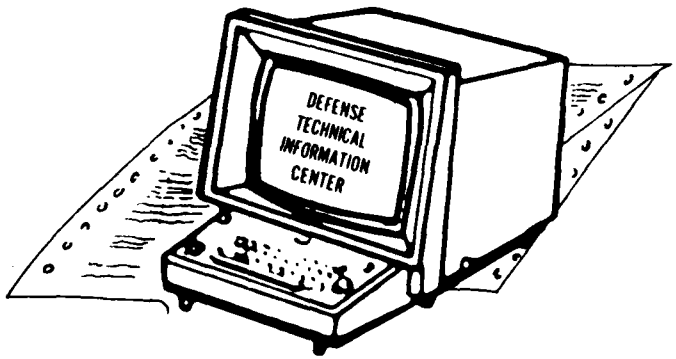


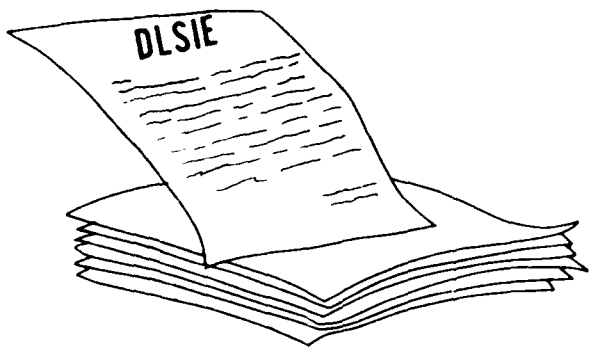
DEGREE OF QUANTIFICATION OF THE 15 ILS ASSESSMENT CONSIDERATIONS

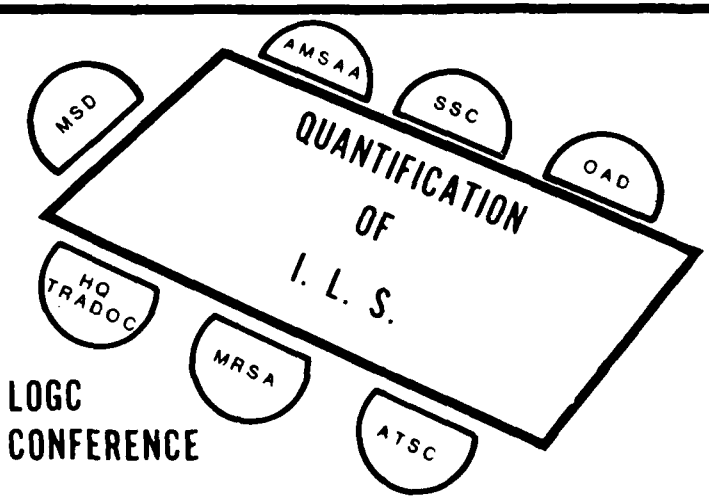
- CATEGORIZING THE 15 ILS ASSESSMENT CONSIDERATIONS BY THE LEVEL WHICH THEY CAN BE QUANTIFIED
  - HIGH DEGREE
  - MODERATE DEGREE
  - LOW DEGREE

BACKGROUND INFORMATION









LOGC
CONFERENCE

WO# 430-84
CMD GP

BACKGROUND INFORMATION

** CONDUCTED LITERATURE SEARCH FOR QUANTIFICATION OF ILS METHODOLOGY

*** DEFENSE LOGISTICS STUDIES INFORMATION EXCHANGE (DLSIE)

*** DEFENSE TECHNICAL INFORMATION CENTER (DTIC)

*** DR SIMS (LOGC HISTORIAN)

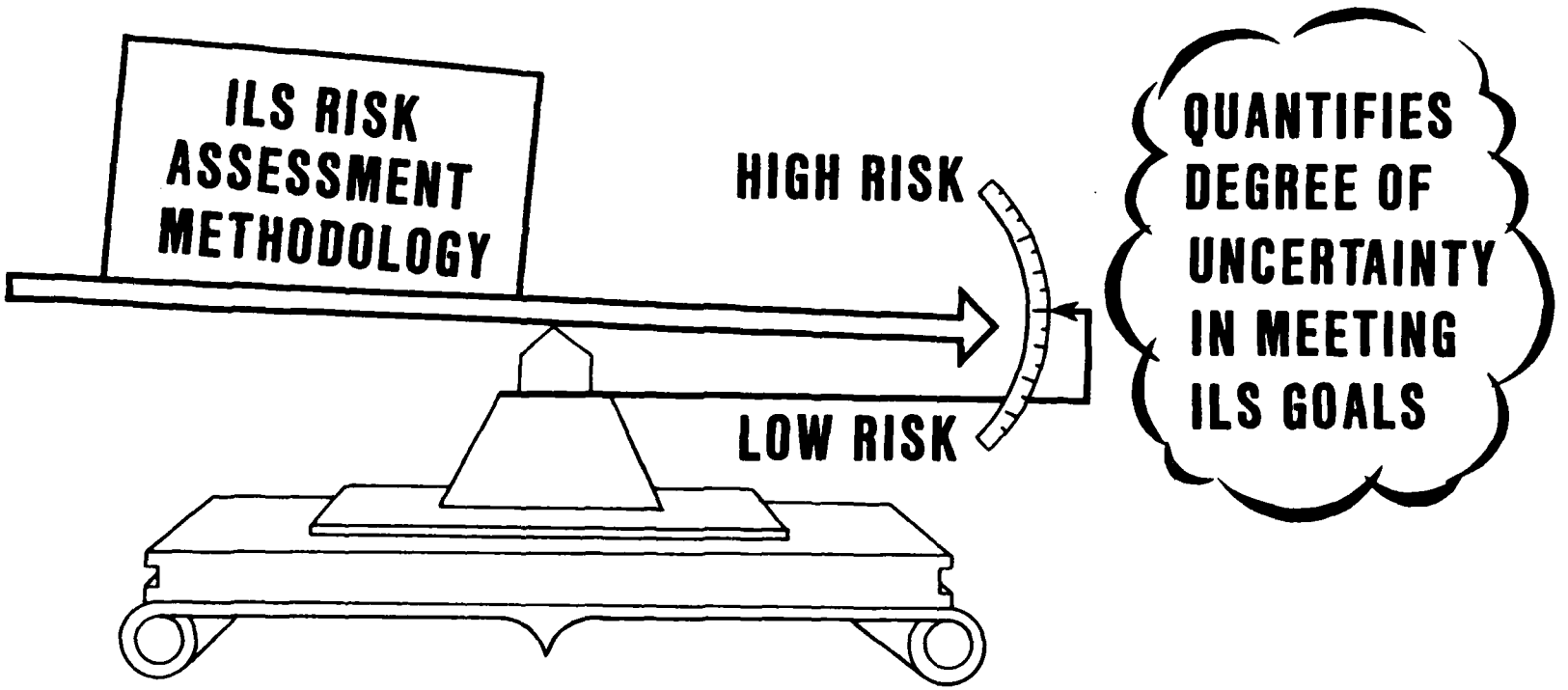
** LOGC HOSTED CONFERENCE-14 NOV 83

HQ TRADOC	SSC
MRSA	AMSAA
ATSC	LOGC (MSD/OAD)

** LOGC DEVELOPED RISK ASSESSMENT METHODOLOGY -FEB 84

** CG LOGC METHODOLOGY REVIEW-5 MAR 84

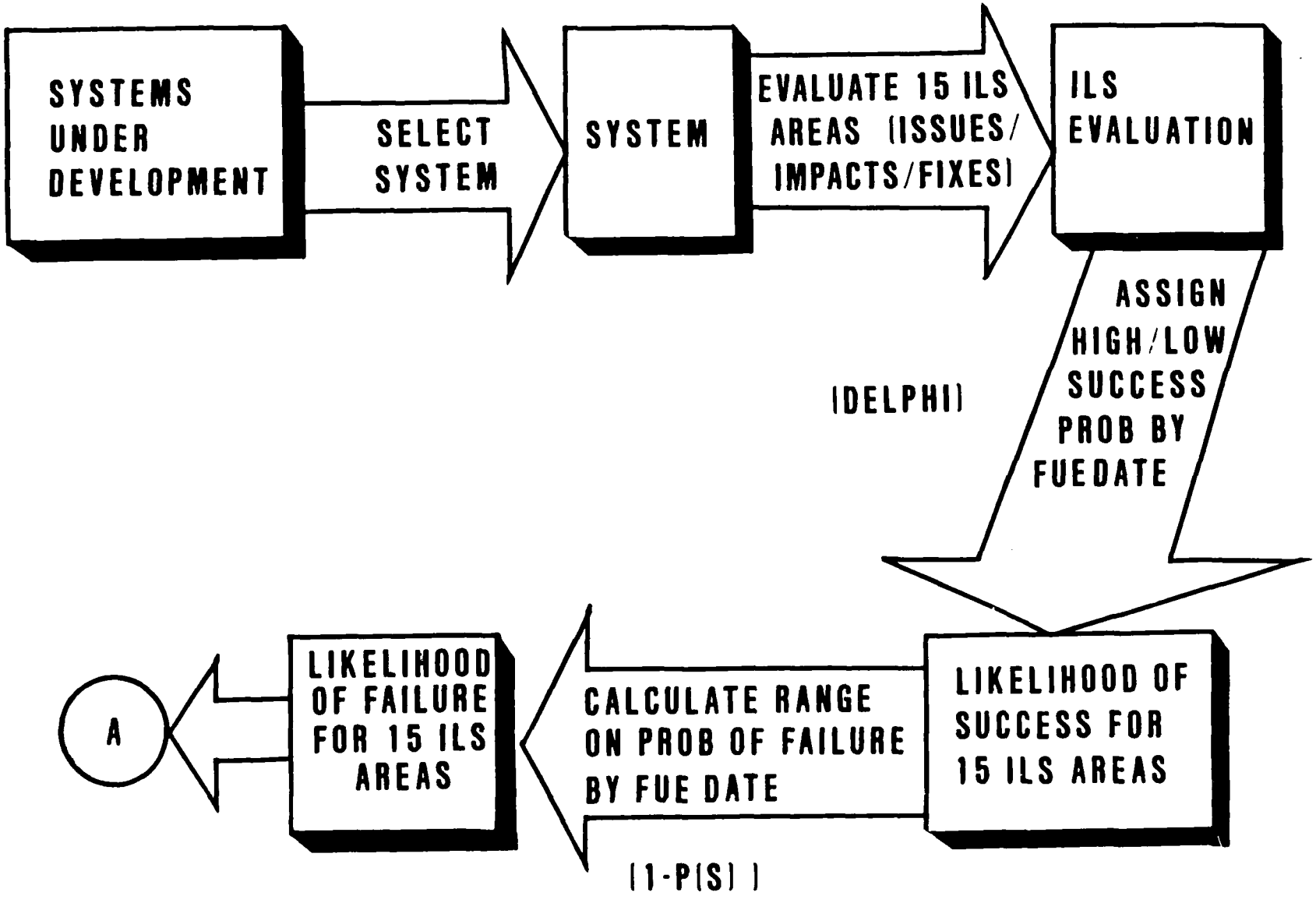
METHODOLOGY FOR ILS QUANTIFICATION



RISK ASSESSMENT FOR ILS

TO PROVIDE METHODOLOGY WHICH QUANTIFIES THE DEGREE OF UNCERTAINTY WHICH MAY SUR-ROUND DEVELOPMENTAL SYSYEMS IN TERMS OF MEETING ILS GOALS/OBJECTIVES.

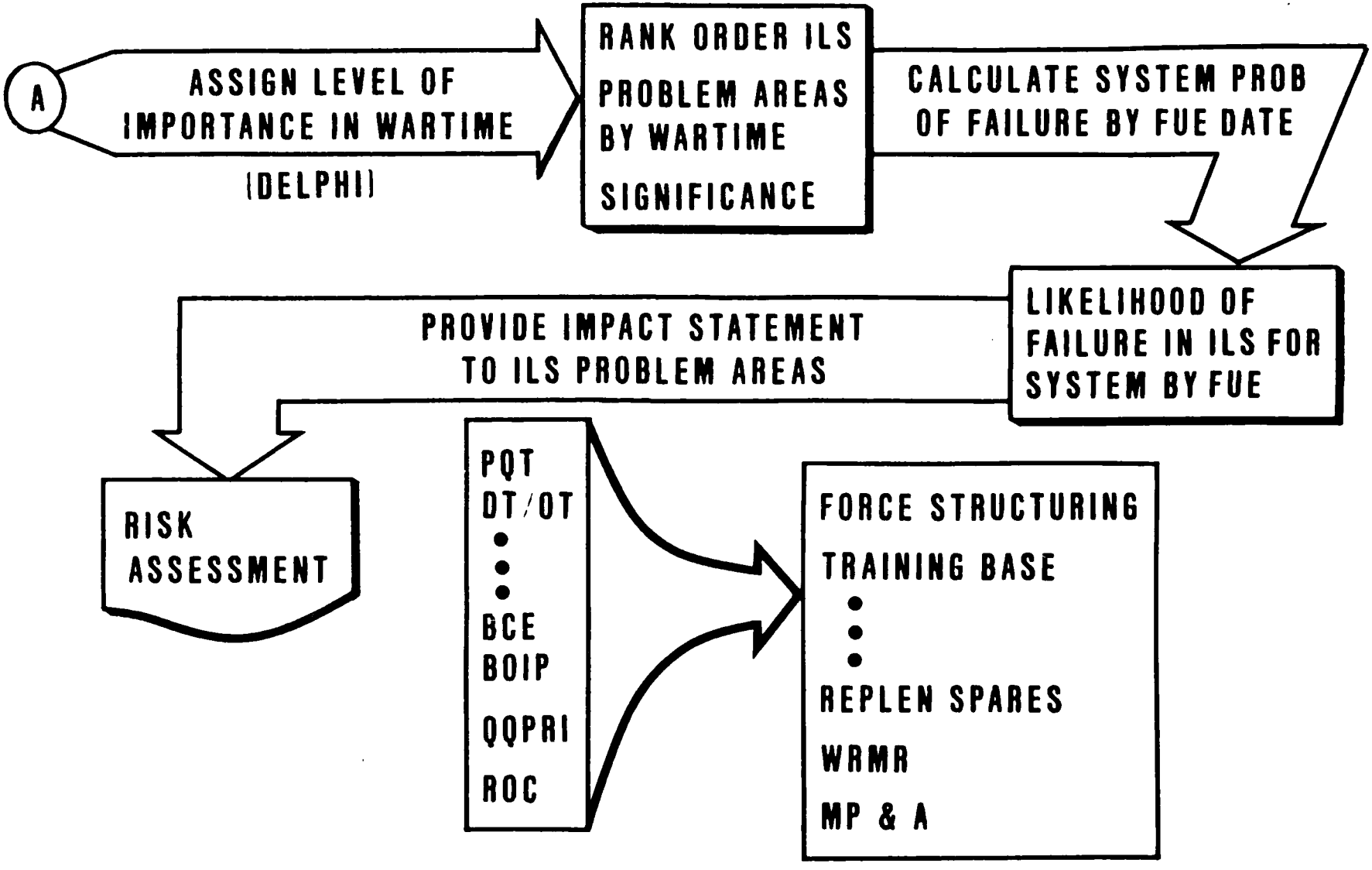
PROCESS DEFINITION



PROCESS DEFINITION

- SELECT SYSTEM
- EVALUATE 15 ASSESSMENT AREAS BY THE LOGISTIC EVALUATION GROUP (PER AR 700-127)
  - ISSUES
  - PROPOSED FIXES
  - QUALITATIVE IMPACTS
- HOST DELPHI MEETING TO ASSIGN HIGH/LOW SUCCESS LEVEL
  - SUCCESS = EACH ASSESSMENT AREA WILL BE ON SCHEDULE AND WORK AS INTENDED BY FUE
- CALCULATE RANGE ON FAILURE LEVEL FOR EACH AREA
  - FAILURE = 1-PROBABILITY OF SUCCESS

PROCESS DEFINITION



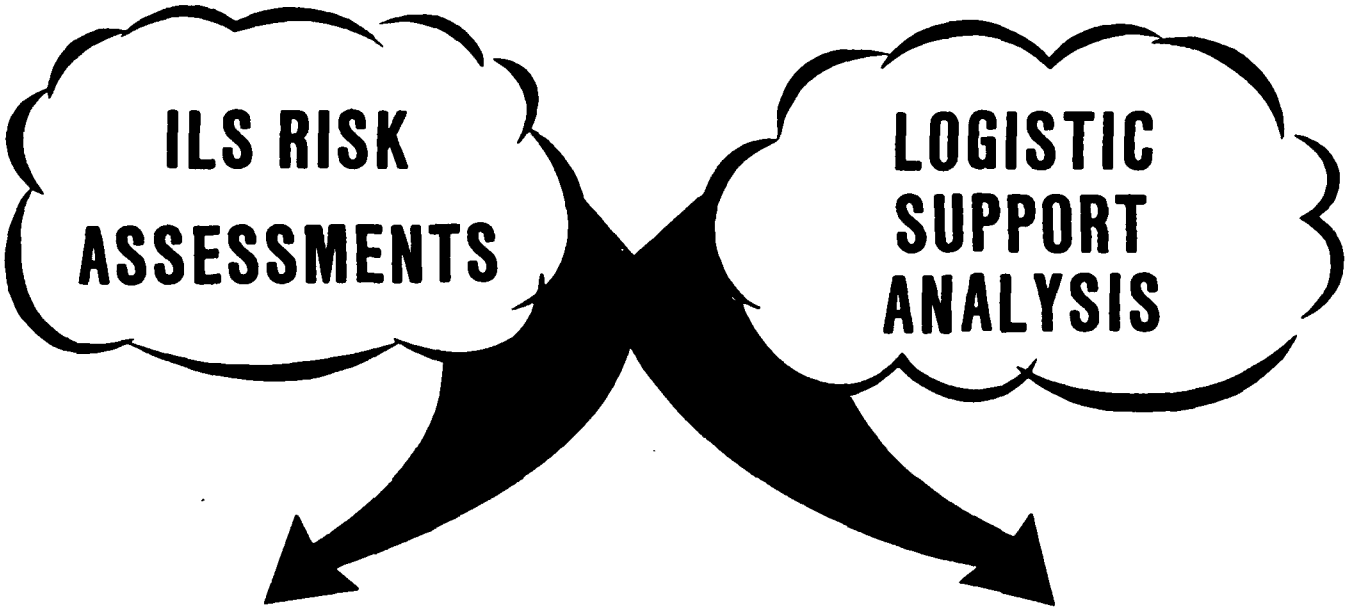
PROCESS DEFINITION

- ASSIGN AN IMPORTANCE FACTOR BY DELPHI GROUP TO EACH ASSESSMENT AREA FOR ITS CRITICALITY IN A WARTIME DEPLOYMENT (INCREASING VALUE INCREASING IMPORTANCE)
- CALCULATE OVERALL SYSTEM SCORE ACROSS ALL FIFTEEN ASSESSMENT AREAS WEIGHTED BY THEIR WARTIME IMPORTANCE
- 'QUANTIFY' THESE AREAS WHICH WERE IDENTIFIED AS PROBLEM AREAS BY APPLYING DECISION CRITERIA
  - DECISION CRITERIA (E.G.,) MAXIMUM SUCCESS PROBABILITY BY FUE OF LESS THAN 50%

DELPHI PROCESS

- DELPHI GROUP PROVIDED WITH FOLLOWING BY LOG EVALUATION GROUP (LEG)
  - IDENTIFIED ISSUES FOR EACH ASSESSMENT AREA
  - QUALITATIVE IMPACTS TO ARMY OF PRESENT PERFORMANCE
  - IDENTIFIED FIXES IF REQUIRED TO GET BACK ON TARGET GOALS
- DELPHI GROUP OBJECTIVES
  - ASSIGN A RANGE (HIGH/LOW) SUCCESS PROBABILITY TO EACH ASSESSMENT AREA
  - ASSIGN A WARTIME IMPORTANCE FACTOR TO EACH AREA
- BASED ON DELPHI RESULTS THE LEG PROVIDES TO ARMY MGMT
  - SYSTEM LEVEL SUCCESS RANGES
  - "QUANTIFIED" IMPACTS WHEN POSSIBLE
  - FORECASTED PERFORMANCE LEVELS COMPARED TO TARGET GOALS

INTERFACE WITH LSA



SYSTEM ILS IMPACTS

(FIELDING ASSESSMENTS)

- **LSA TASK 303**
- **LSA TASK 402**

ILS PRODUCT MANAGEMENT

(COST VS SCHEDULING)

- **LSA TASK 103**

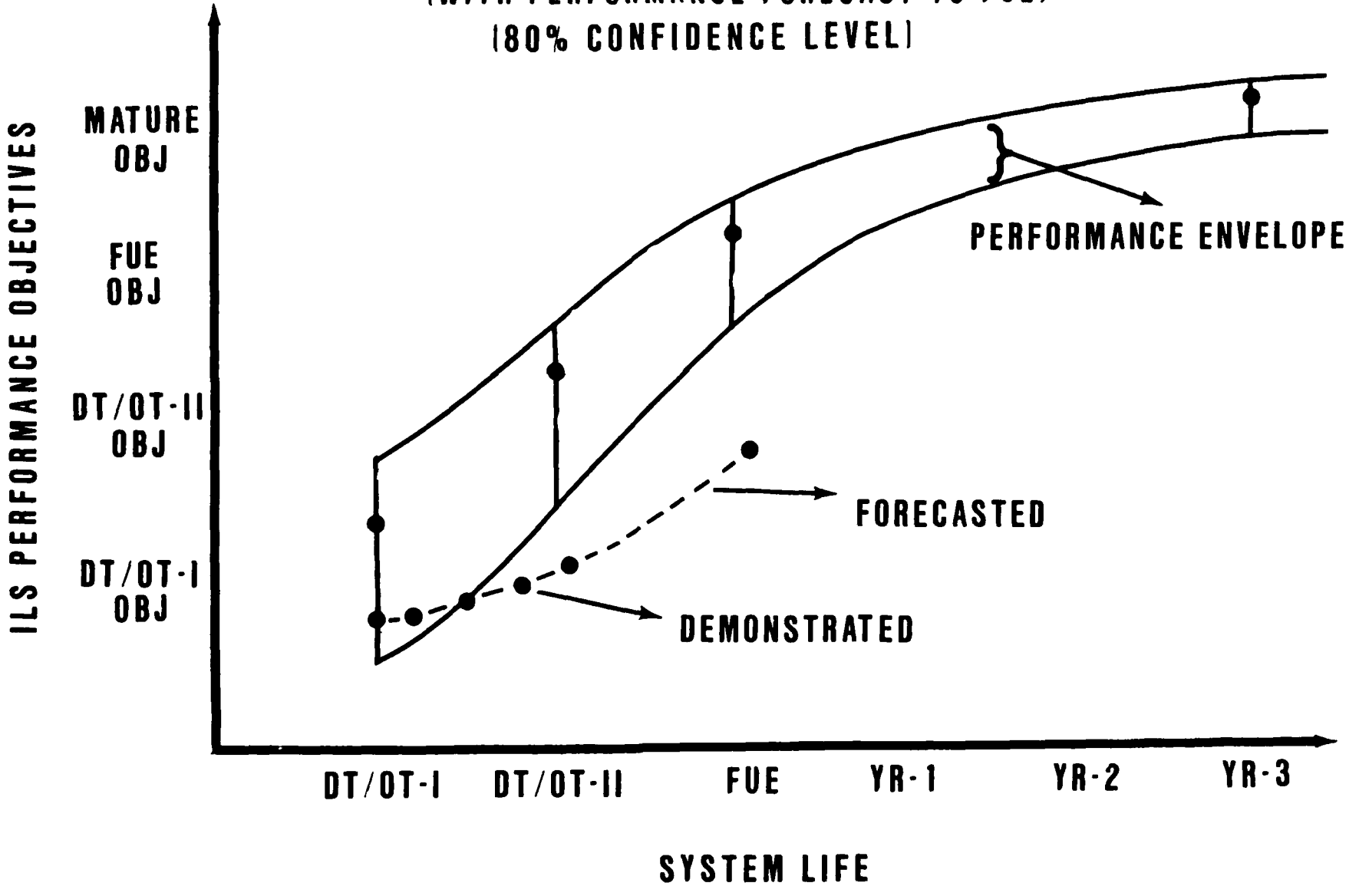
INTERFACE OF ILS RISK ASSESSMENT & LSA TASKS

- TWO MODES FOR ASSESSING RISK
  - ILS PRODUCT MANAGEMENT
  - SYSTEM ILS IMPACTS
- THREE LSA TASKS FOR INCLUDING RISK ASSESSMENT UNDER TWO MODES
  - LSA 103 - PROGRAM & DESIGN REVIEWS (MANAGEMENT ASSESSMENT)
  - LSA 303 -- EVALUATION OF ALTERNATIVES & TRADEOFF ANALYSIS (SYSTEM IMPACTS)
  - LSA 402 - EARLY FIELDING ANALYSIS (SYSTEM IMPACTS)

SYSTEM GROWTH UNDER RISK ACROSS TIME

(WITH PERFORMANCE FORECAST TO FUE)

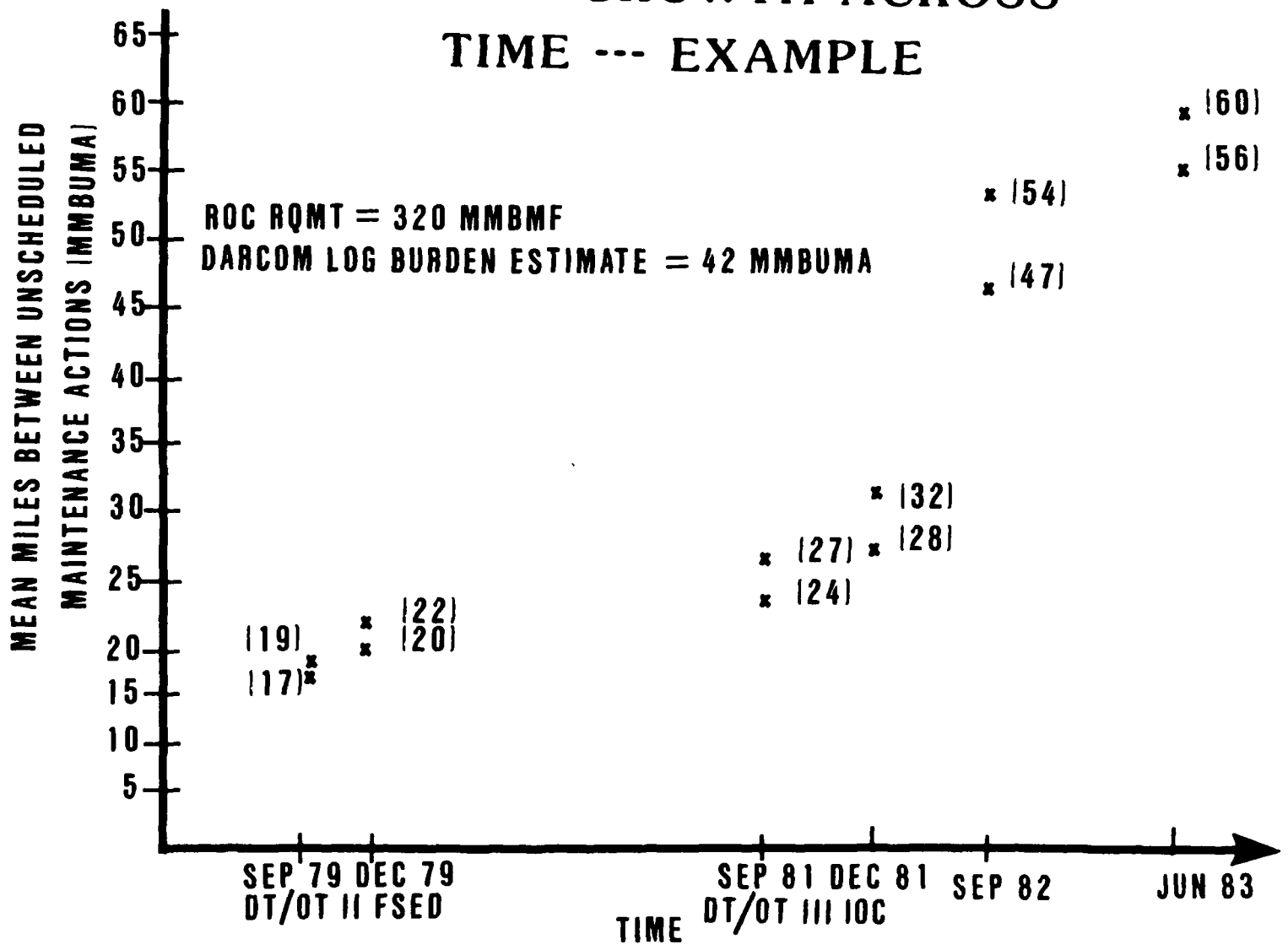
(80% CONFIDENCE LEVEL)



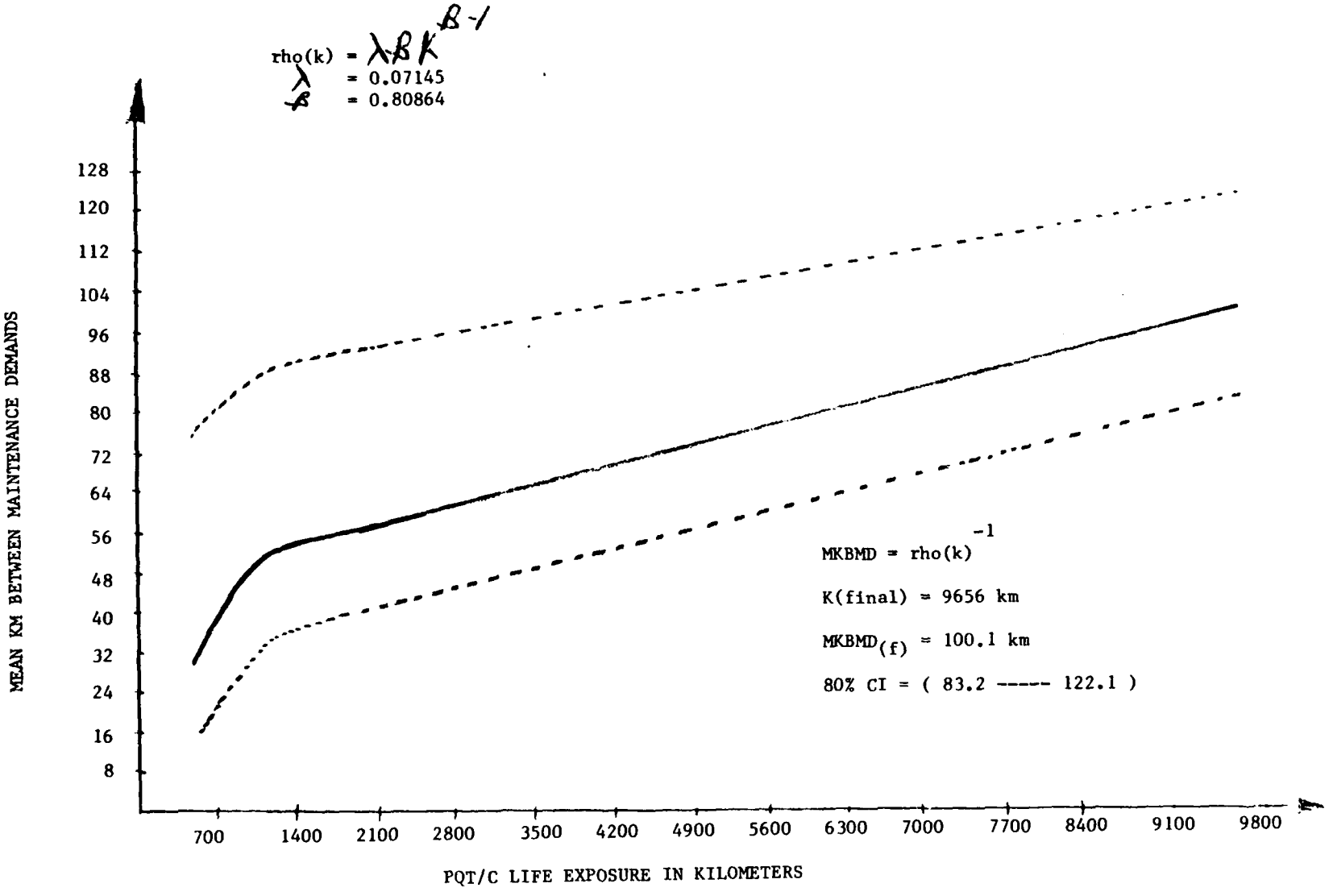
SYSTEM GROWTH UNDER RISK

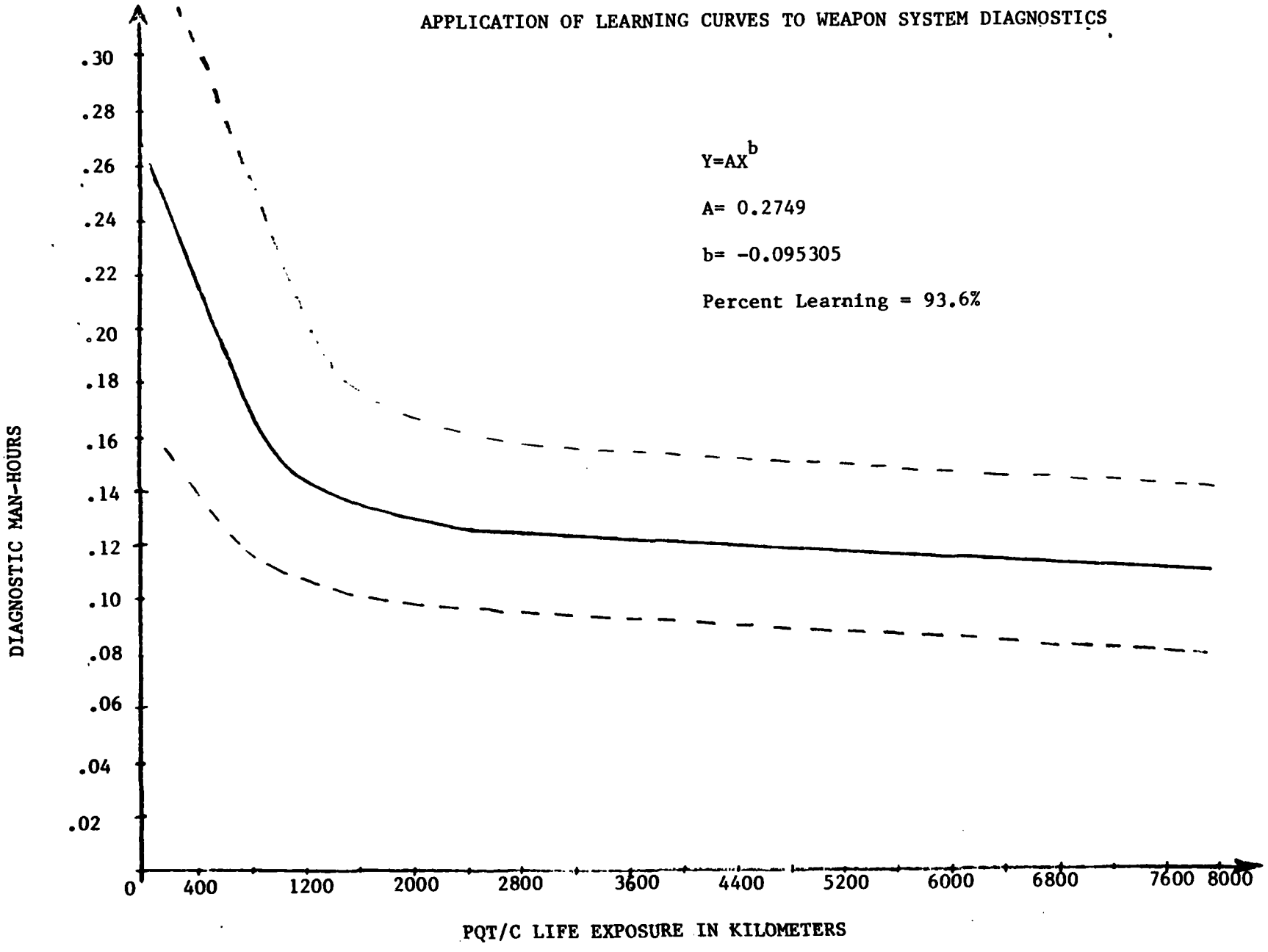
- ESTABLISH A PERFORMANCE ENVELOPE AS SYSTEM OBJECTIVES IN LIEU OF POINT ESTIMATES
  - USER TO SET FUE & MATURE WINDOWS THROUGH REQUIREMENTS DOCUMENTS
  - MATERIEL DEVELOPER TO SET DT/OT WINDOWS THROUGH LSA PLAN
- PROACTIVE RESPONSE TO DOD & GAO INQUIRIES
  - ALLOWS ARMY MANAGEMENT TO TRACK BOTH DEMONSTRATED AND FORECASTED PERFORMANCE VS STATED OBJECTIVES
  - BY SETTING 'UPPER' AS WELL AS 'LOWER' PERFORMANCE BOUNDS, ARMY AVOIDS 'GOLD PLATING' CRITICISM
- NOT ALL FIFTEEN ASSESSMENT AREAS ARE AMENABLE TO CONTINUOUS MEASURES

SYSTEM GROWTH ACROSS TIME --- EXAMPLE



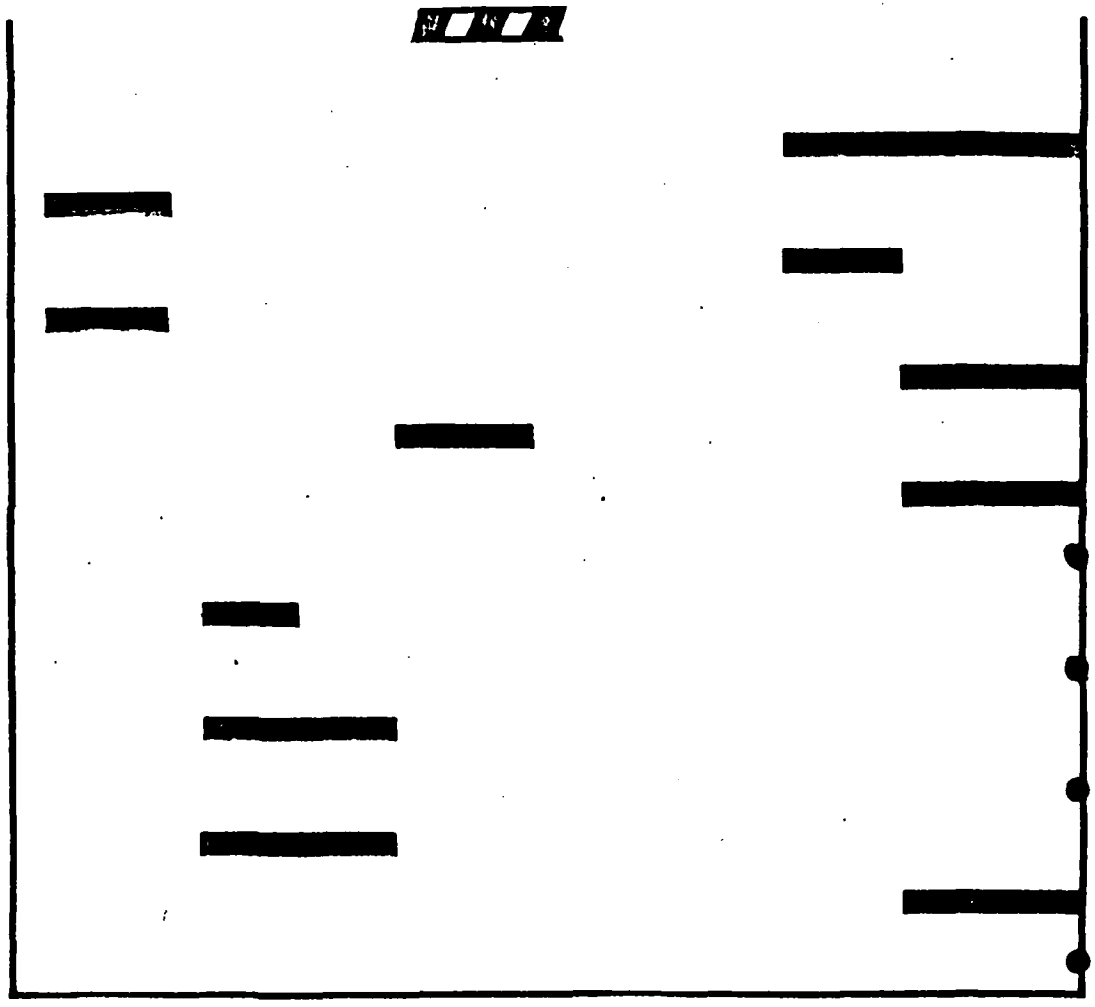
APPLICATION OF WEIBULL INTENSITY GROWTH FUNCTIONS TO PQT/C




APPLICATION OF LEARNING CURVES TO WEAPON SYSTEM DIAGNOSTICS
Y=AX^b
A= 0.2749
b= -0.095305
Percent Learning = 93.6%
DIAGNOSTIC MAN-HOURS
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
400
1200
2000
2800
3600
4400
5200
6000
6800
7600
8000
PQT/C LIFE EXPOSURE IN KILOMETERS

ILS RISK ASSESSMENT

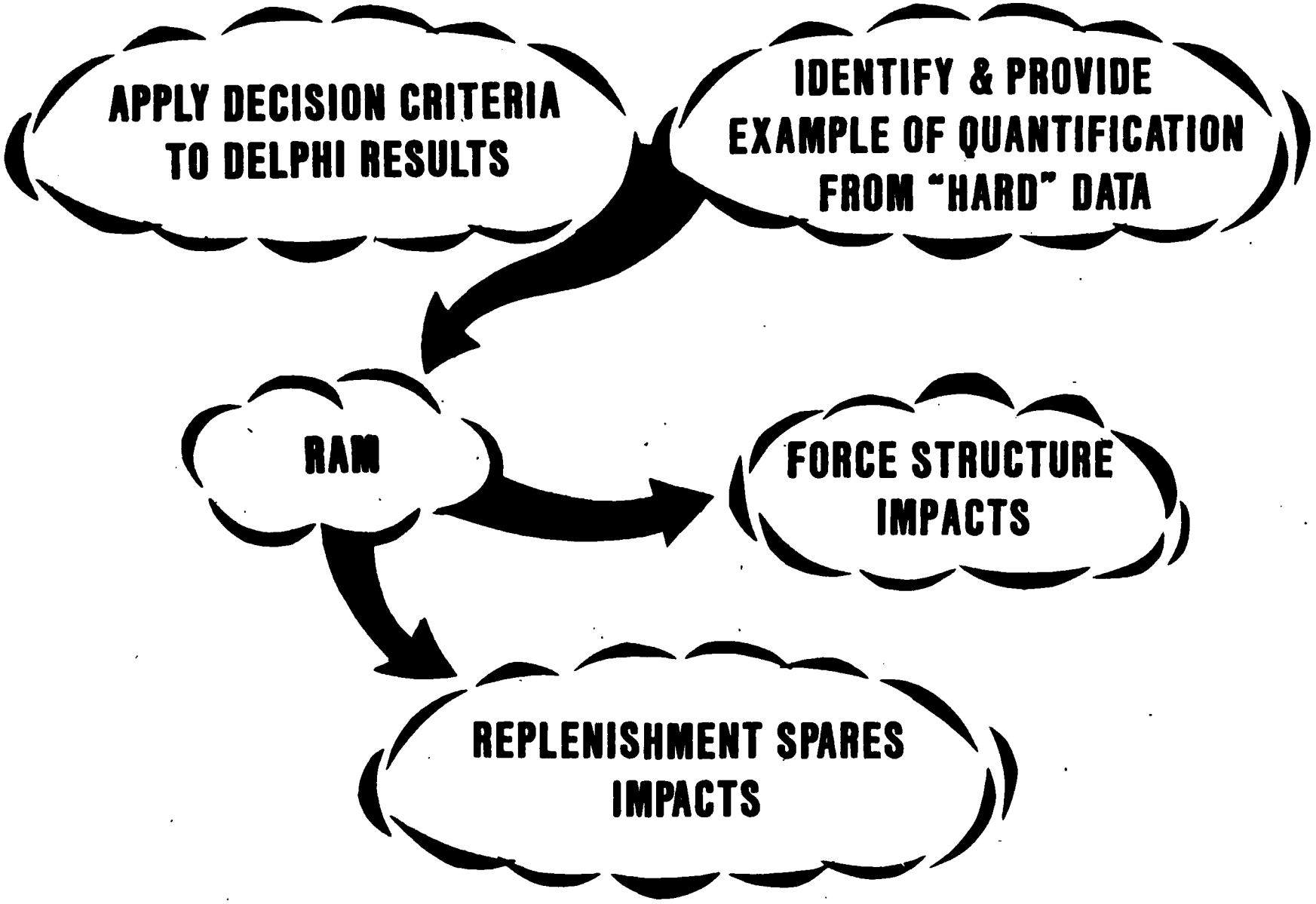
WGT	SYSTEM ELEMENT
5	MAINT PLAN
9	SPT/TEST EQUIP
4	SUPPLY SPT
7	XPORT & XPORT
1	TECH DATA
4	MNPWR& PERS
2	TRAIN & TR DEV
1	FACILITIES
5	COMP RES SPT
2	MATL FIELD PLAN
8	DESIGN INFL
1	STD & INTEROP
9	RAM
1	SPT MGMT ANALYSIS
1	COST ANA & FUND



DELPHI RISK ASSESSMENT

- EACH ASSESSMENT AREA HAS FOLLOWING PROVIDED
  - WARTIME IMPORTANCE FACTOR (INDICATED BY WGT COLUMN)
  - RANGE ON SUCCESS BY FUE (INDICATED BY BLOCKS - OR - CIRCLE, IF RANGE INAPPROPRIATE)
- OVERALL SYSTEM SCORE OBTAINED BY WEIGHTING EACH ASSESSMENT AREA BY ITS WARTIME IMPORTANCE

QUANTIFY RISK ASSESSMENT -- HARD DATA



QUANTIFY RISK ASSESSMENT
--- HARD DATA

ASSESSMENT

AREA: RAM

SUCCESS LEVEL: 20%----40%

RISK LEVEL: 60%----80%

DIVISIONAL PEACETIME IMPACTS

FORCE STRUCTURE	TRAINING BASE	REPLENISHMENT SPARES
⊢⊣ 39 MECHANICS	⊢⊣ 12 MECHANICS	⊢⊣ 34.5 MILLION FY 84$

DIVISIONAL WARTIME IMPACTS

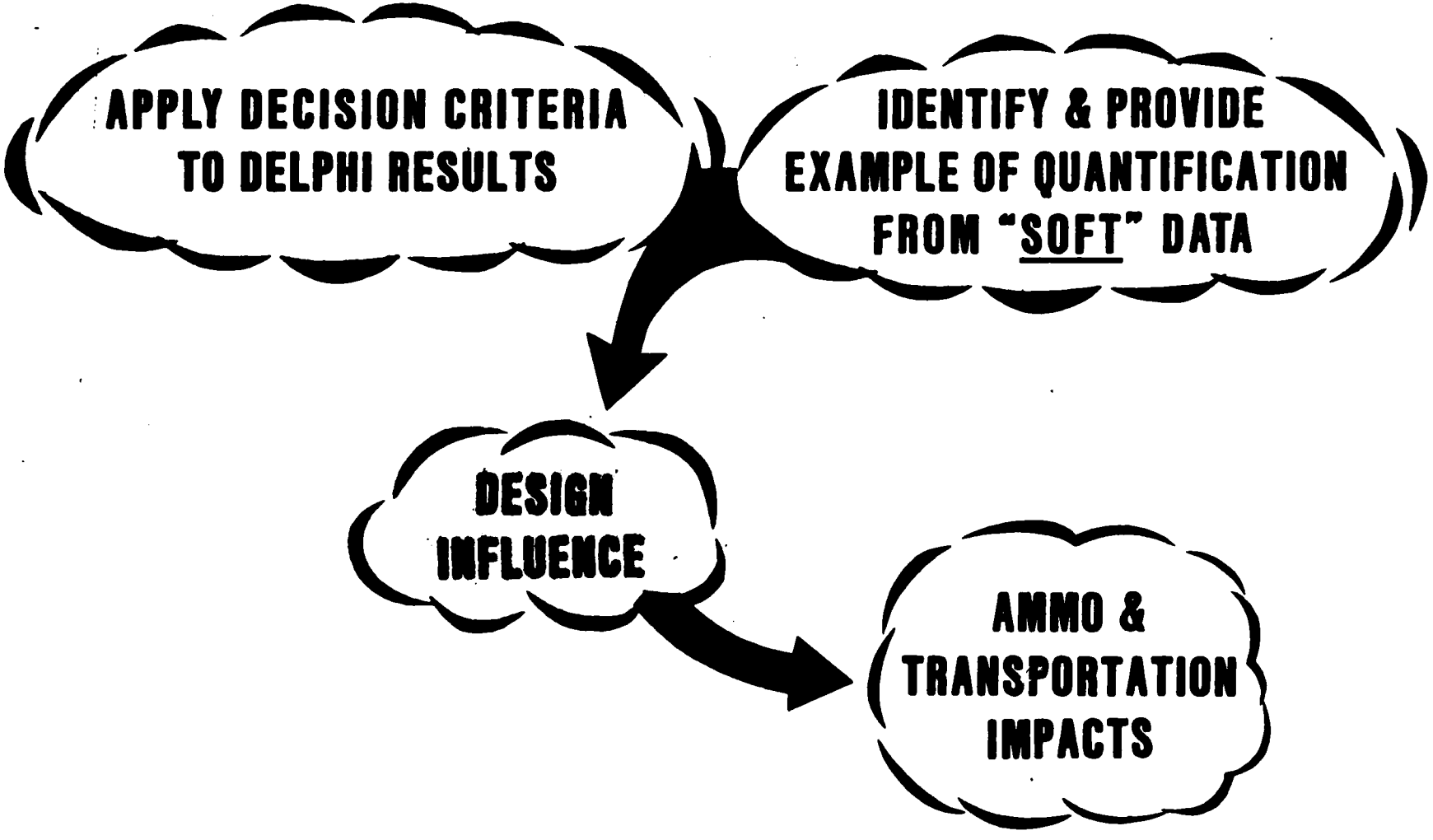
FORCE STRUCTURE	TRAINING BASE	WAR RESERVE MATERIEL RQMT PER BDE
⊢⊣ 39 MECHANICS	⊢⊣ 12 MECHANICS ⊢⊣ WARTIME RE-PLACEMENTS	⊢⊣ 18 MILLION FY 84$ ⊢⊣ CBT DAMAGE REPAIR

CLASS IX MOVEMENT RQMT INTO BDE TRAINS

⊢⊣ 3 FIVE TON LIFTS PER DAY

⊢⊣ LIFT IN SUPPORT OF CBT DAMAGE REPAIR

QUANTIFY RISK ASSESSMENT -- SOFT DATA



QUANTITY RISK ASSESSMENT
--- SOFT DATA

ASSESSMENT
AREA: DESIGN INFLUENCE

SUCCESS LEVEL : 20%---40%

RISK LEVEL: 60%---80%

ISSUE: AMMO DEGRADATION DUE TO STORAGE RACK/TUBE DAMAGE TO 120MM AMMO.

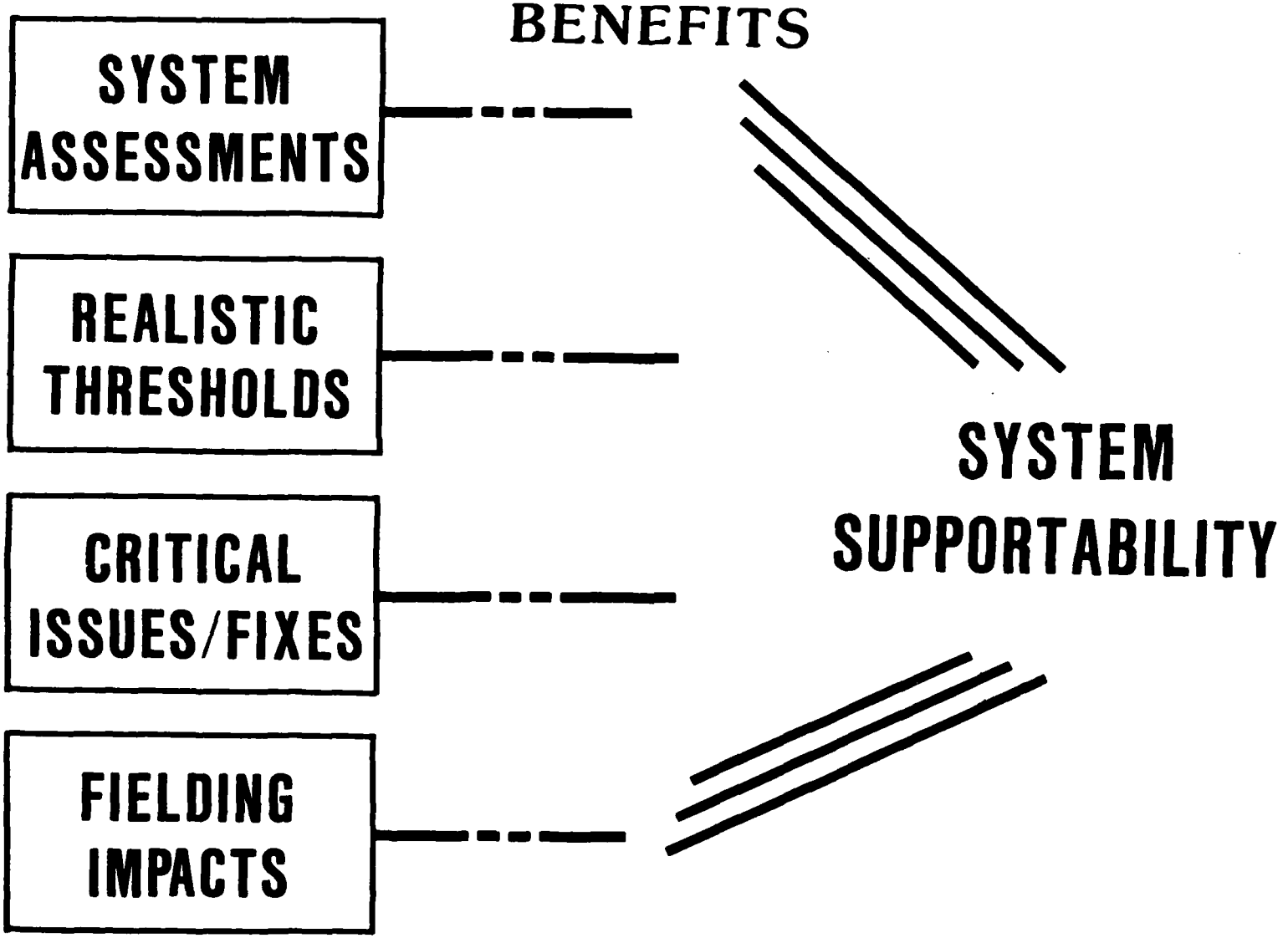
ASSUME:

- WARTIME DAILY ASR---16
- WARTIME RND DAMAGE RATE---1 PER 32 RNDS

WARTIME DAILY EVACUATION RQMT FROM DIVISION:

- 174 RNDS PER DAY
- 4.1 TONS PER DAY FOR EVACUATION ---- OR
  --- DESTROY W/IN DIV

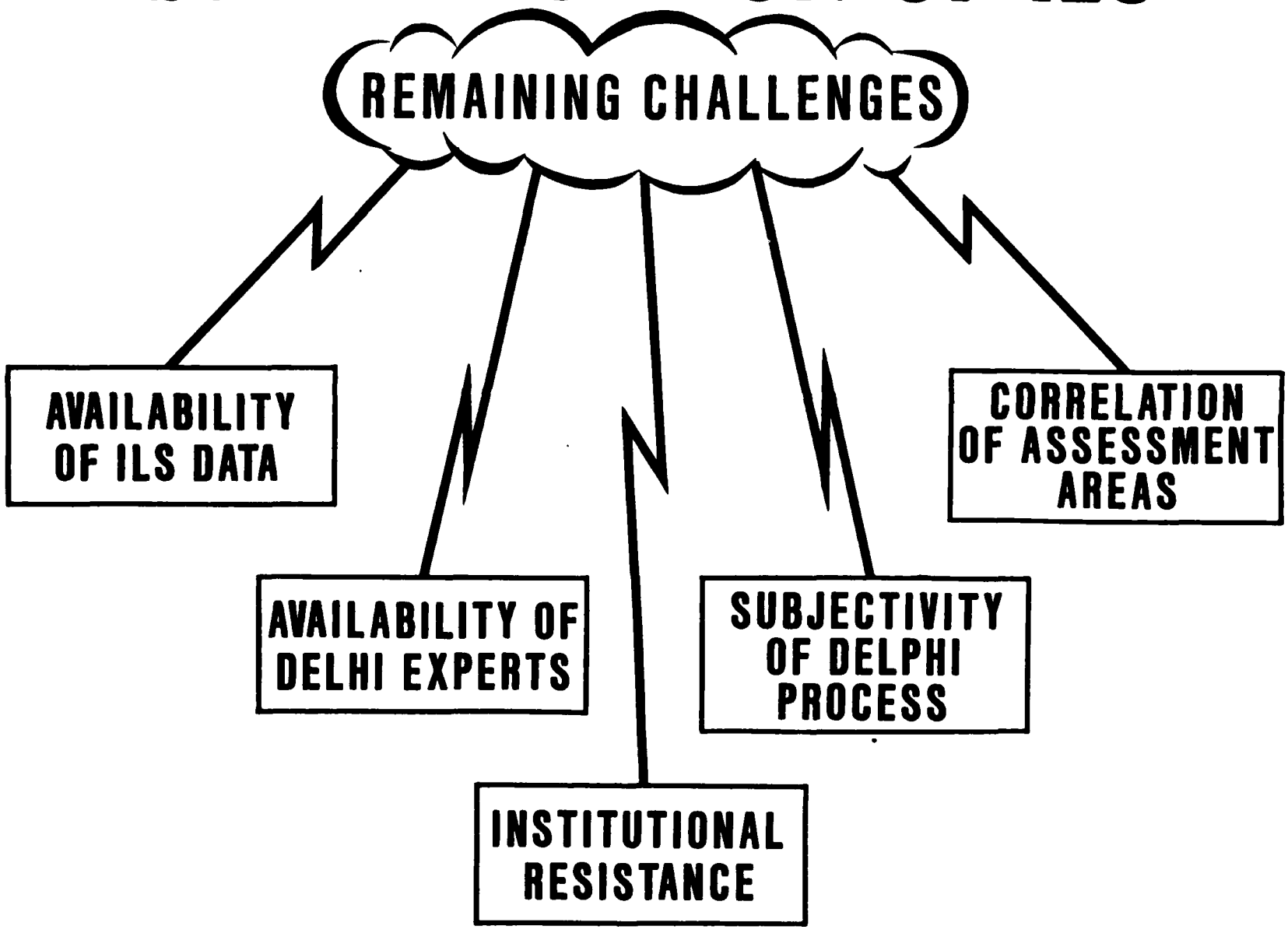
QUANTIFICATION OF ILS BENEFITS



QUANTIFICATION OF ILS
BENEFITS

- PROVIDES A SYSTEMATIC APPROACH FOR A SYSTEM ASSESSMENTS WHICH IS DEFENSIBLE BEFORE GAO & DOD
- PROVIDES REALISTIC THRESHOLDS/OBJECTIVES AGAINST WHICH SYSTEM PROGRESS MAY BE MEASURED
- IDENTIFIES CRITICAL ISSUES AND PROPOSED FIXES PRIOR TO A DECISION MILESTONE
- QUANTIFIES THE IMPACT OF FIELDING A SYSTEM AT SPECIFIED PERFORMANCE LEVELS

QUANTIFICATION OF ILS

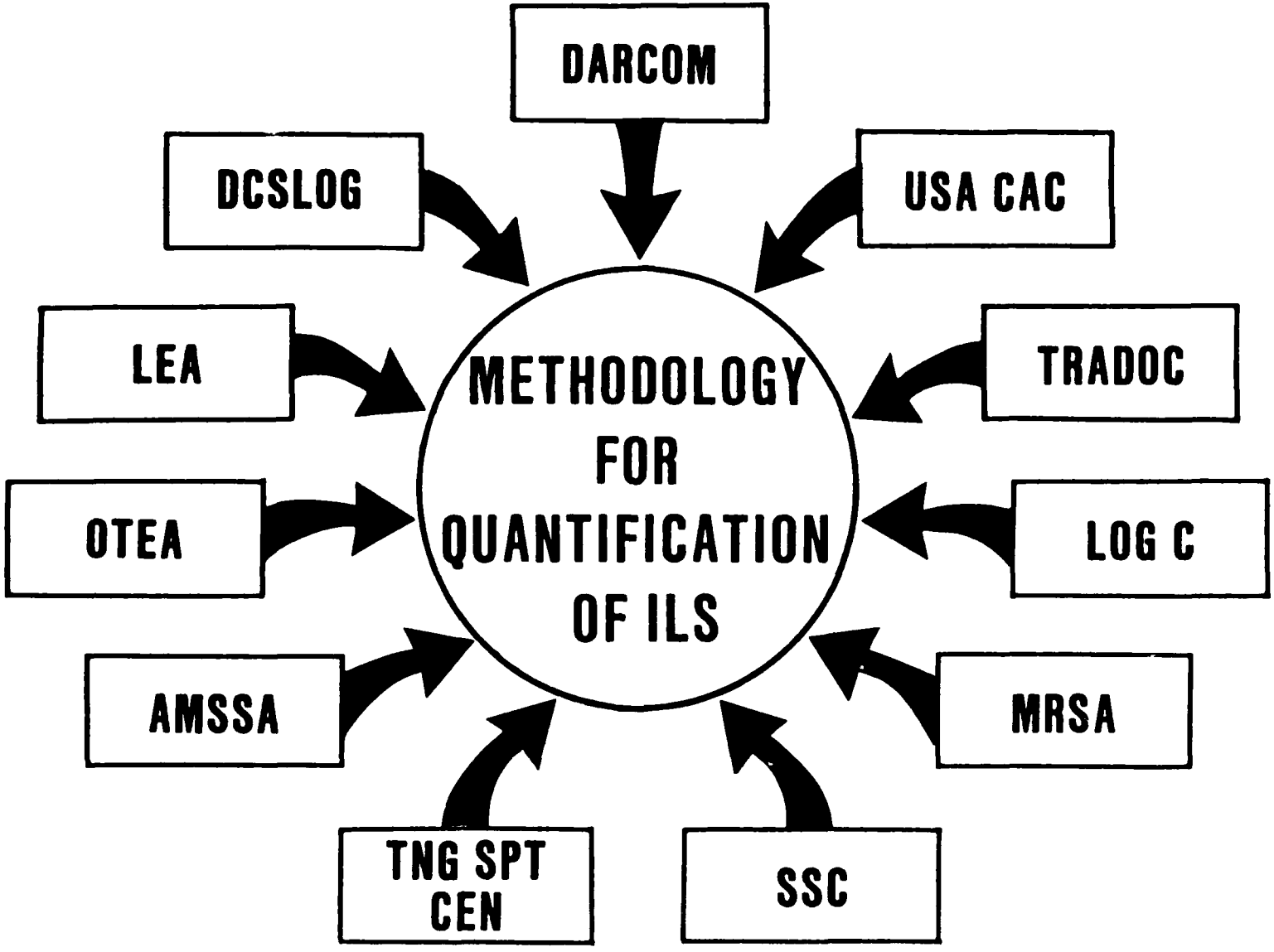


QUANTIFICATION OF ILS: REMAINING CHALLENGES

* GENERAL QUESTIONS
  ** WHAT MECHANISM WILL BE USED TO ASSURE THE AVAILABILITY OF ILS DATA?
  ** WHAT IS THE AVAILABILITY OF THE "EXPERTS" TO PARTICIPATE IN THE DELPHI PROCESS?
  ** CAN WE OVERCOME THE INSTITUTIONAL RESISTANCE TO QUANTIFY ILS?

* ANALYTICAL QUESTIONS
  ** SUBJECTIVITY OF THE DELPHI PROCESS
  ** LACK OF INDEPENDENCE ACROSS 15 ASSESSMENT AREAS AS DEFINED BY AR 700-127
    ***IMPLIES SOME DEGREE OF DOUBLE ACCOUNTING
    ***IMPLIES CORRELATION OF ASSESSMENT AREAS

QUANTIFICATION OF ILS



QUANTIFICATION OF ILS

- CONTINUING EFFORT
  - LOGC WILL HOST TWO DAY WORKING GROUP MTG

DCSLOG	LEA
DARCOM HQ	MRSA
TRADOC HQ	AMSAA
OTEA	SSC
USACAC	TNG SPT CEN

  - INTEGRATE WORKING GROUP CONCERNS INTO METHODOLOGY